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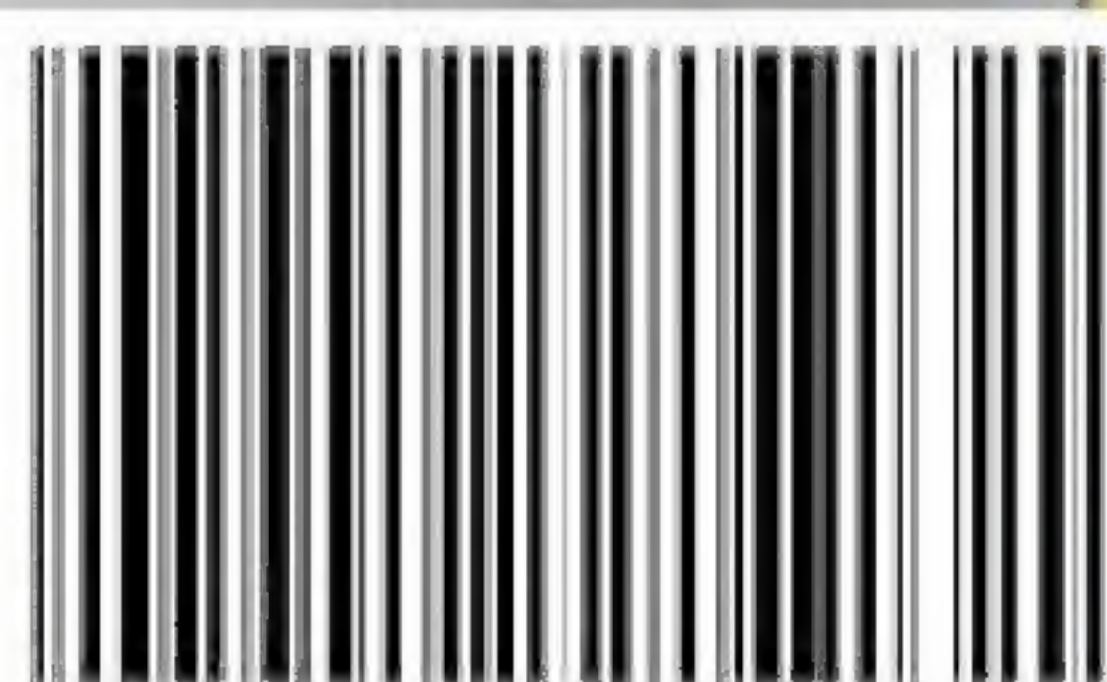
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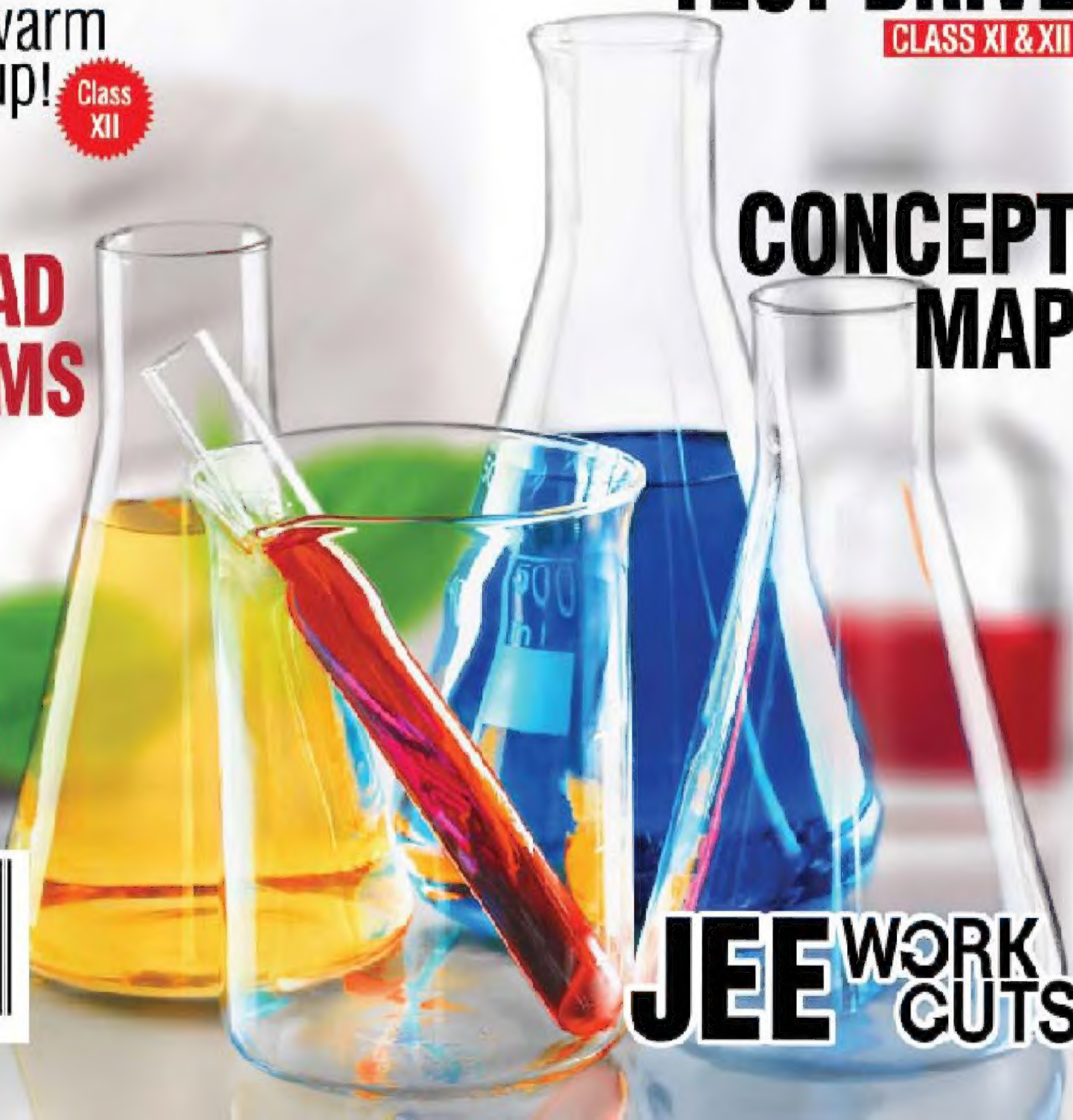
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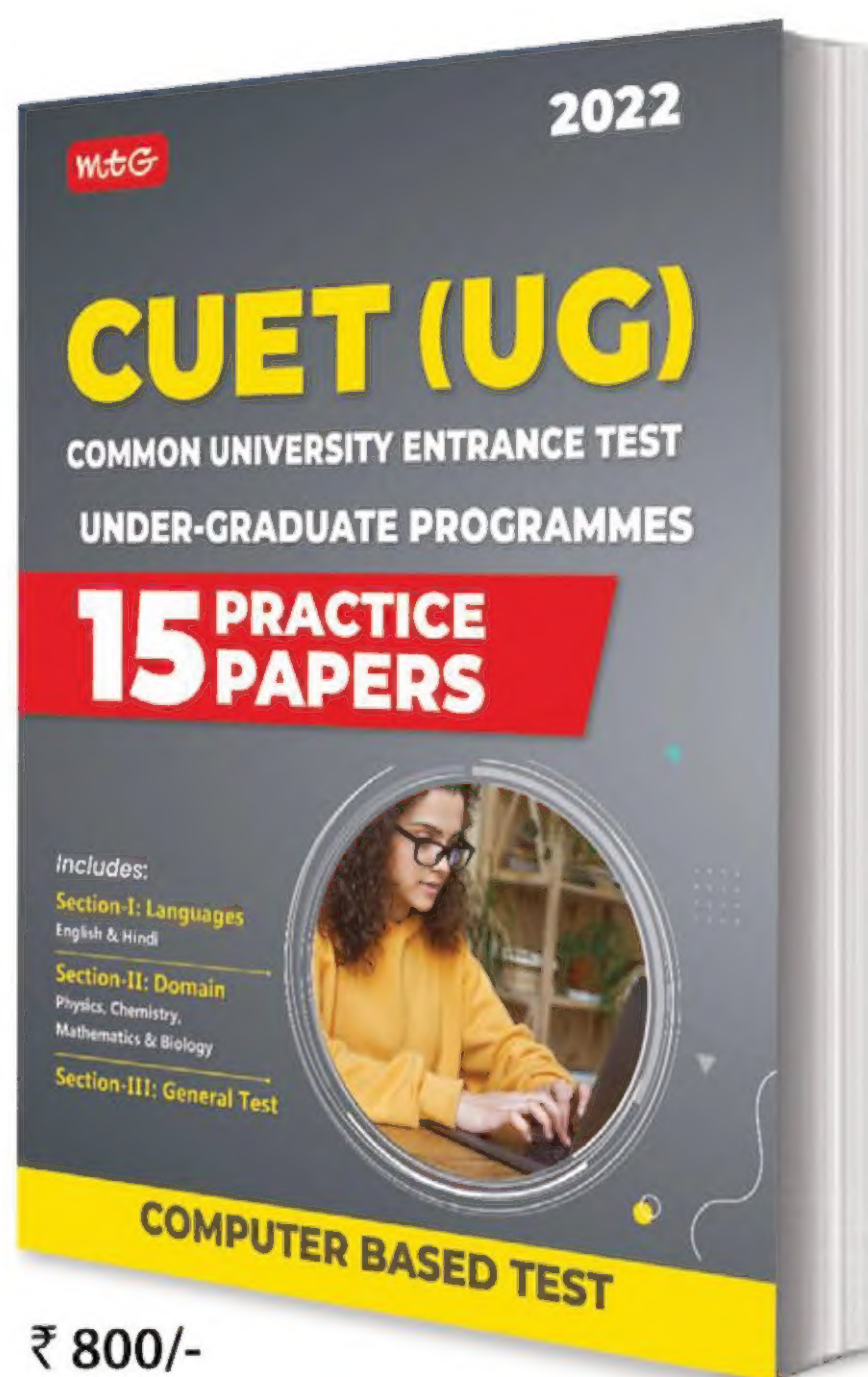
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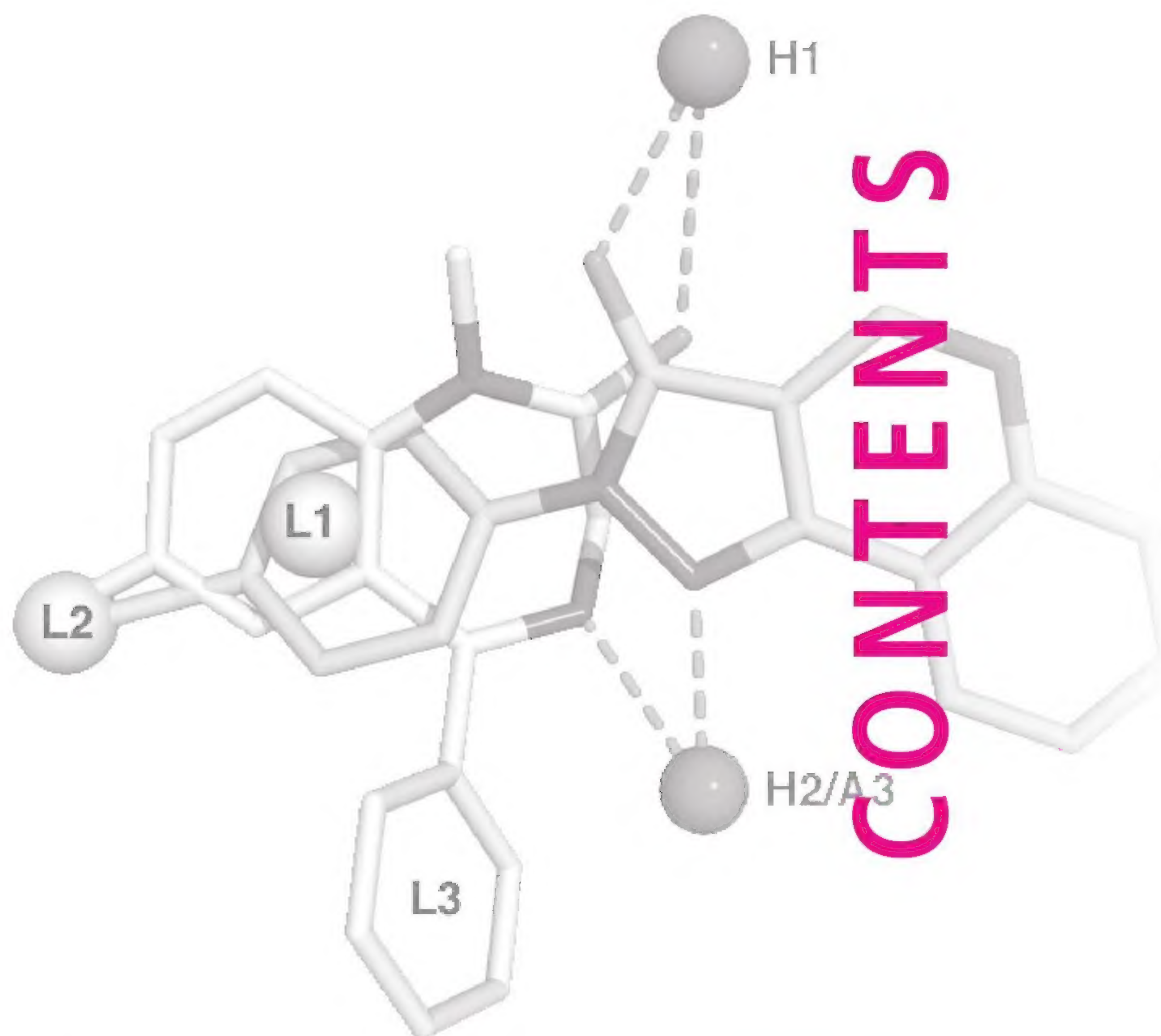
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JEE Work Outs 32

CUET (UG) 42

Practice Paper 2022

**Organic Chemistry :
Some Reduction Reactions** 48

Olympiad Problems 52

Class 11

Get Set Go for JEE 57

Monthly Test Drive 60

Practice Paper

Concept Map 40

Class 12

Get Set Go for NEET 64

Monthly Test Drive 67

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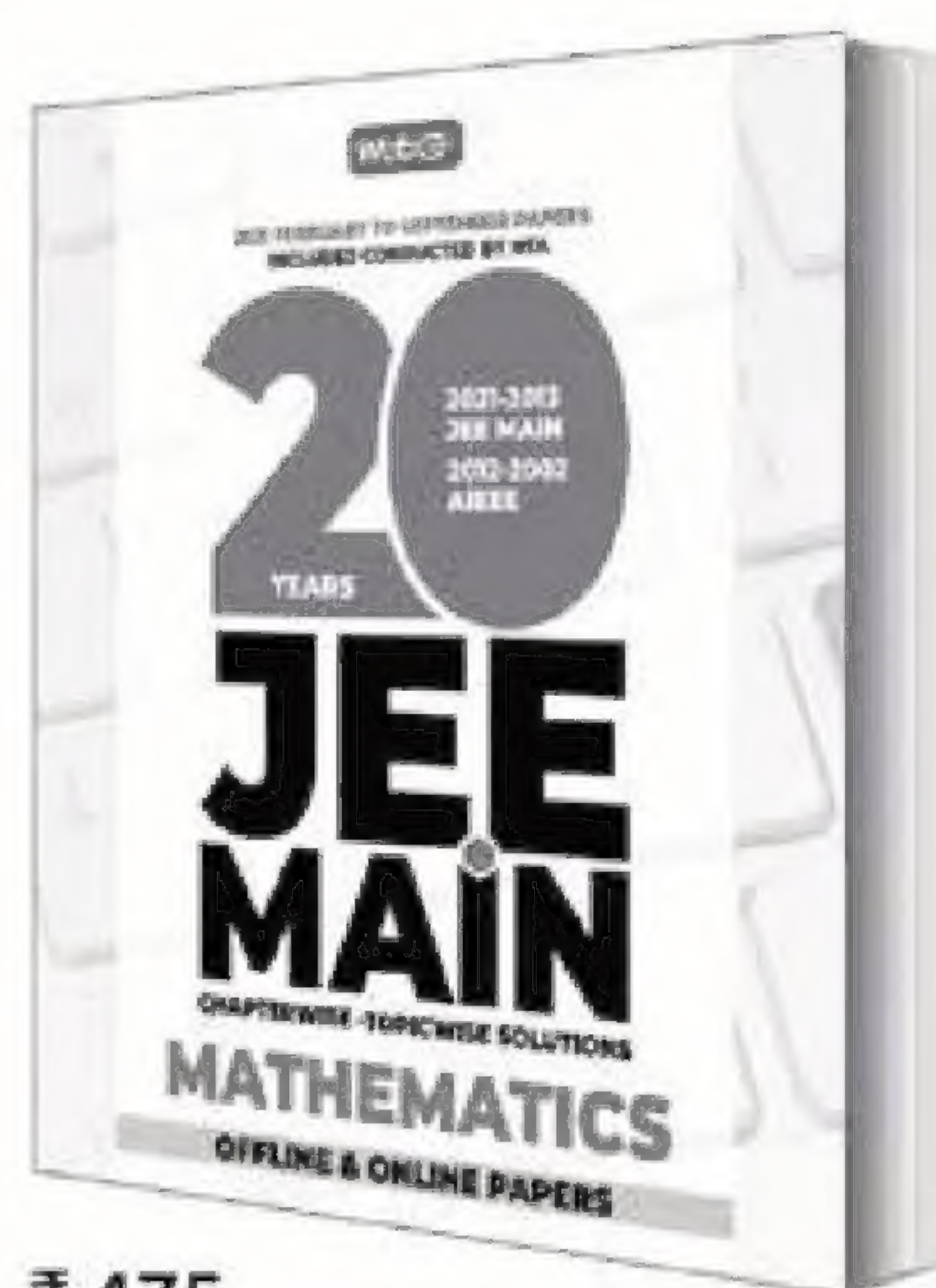
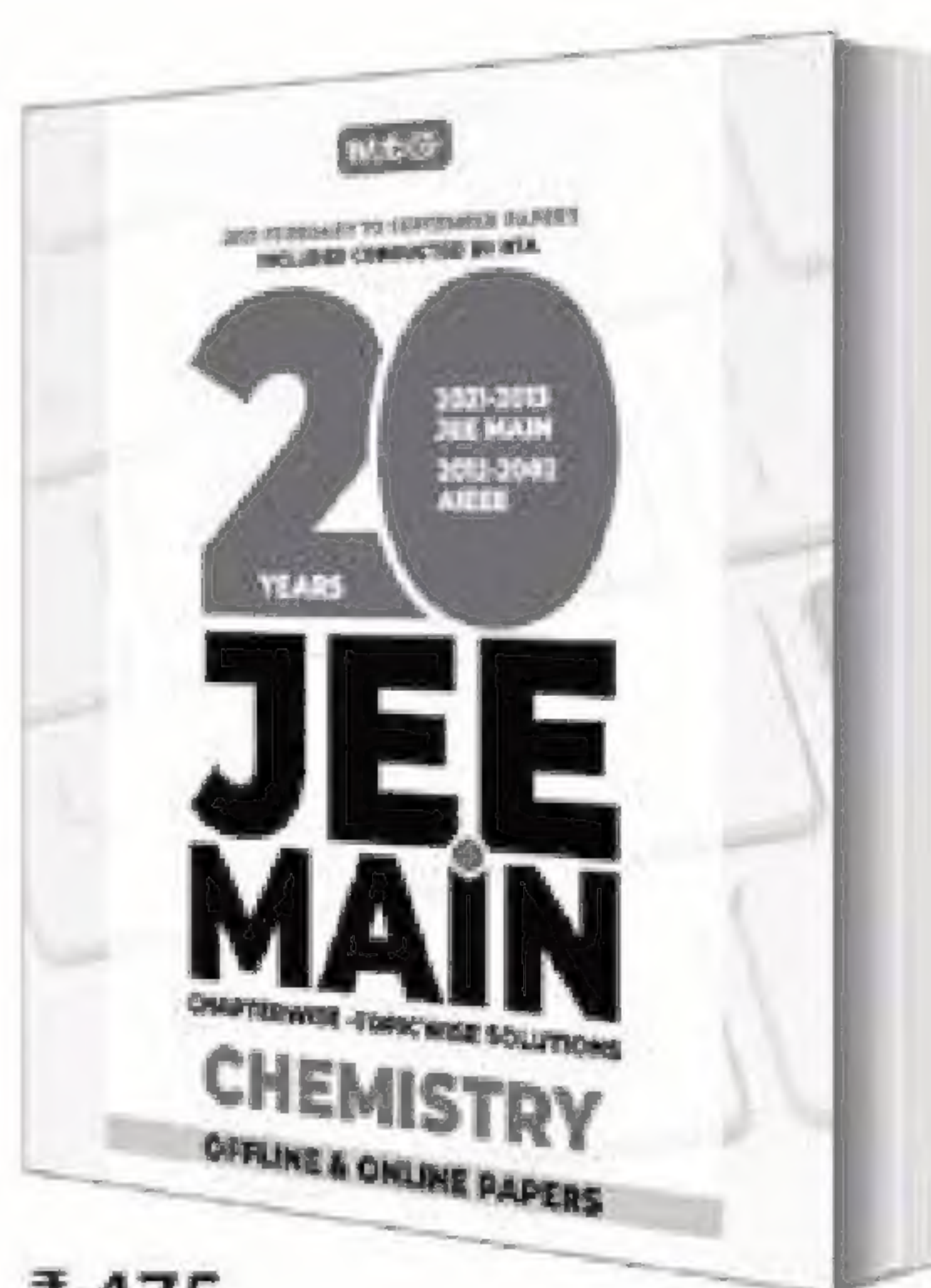
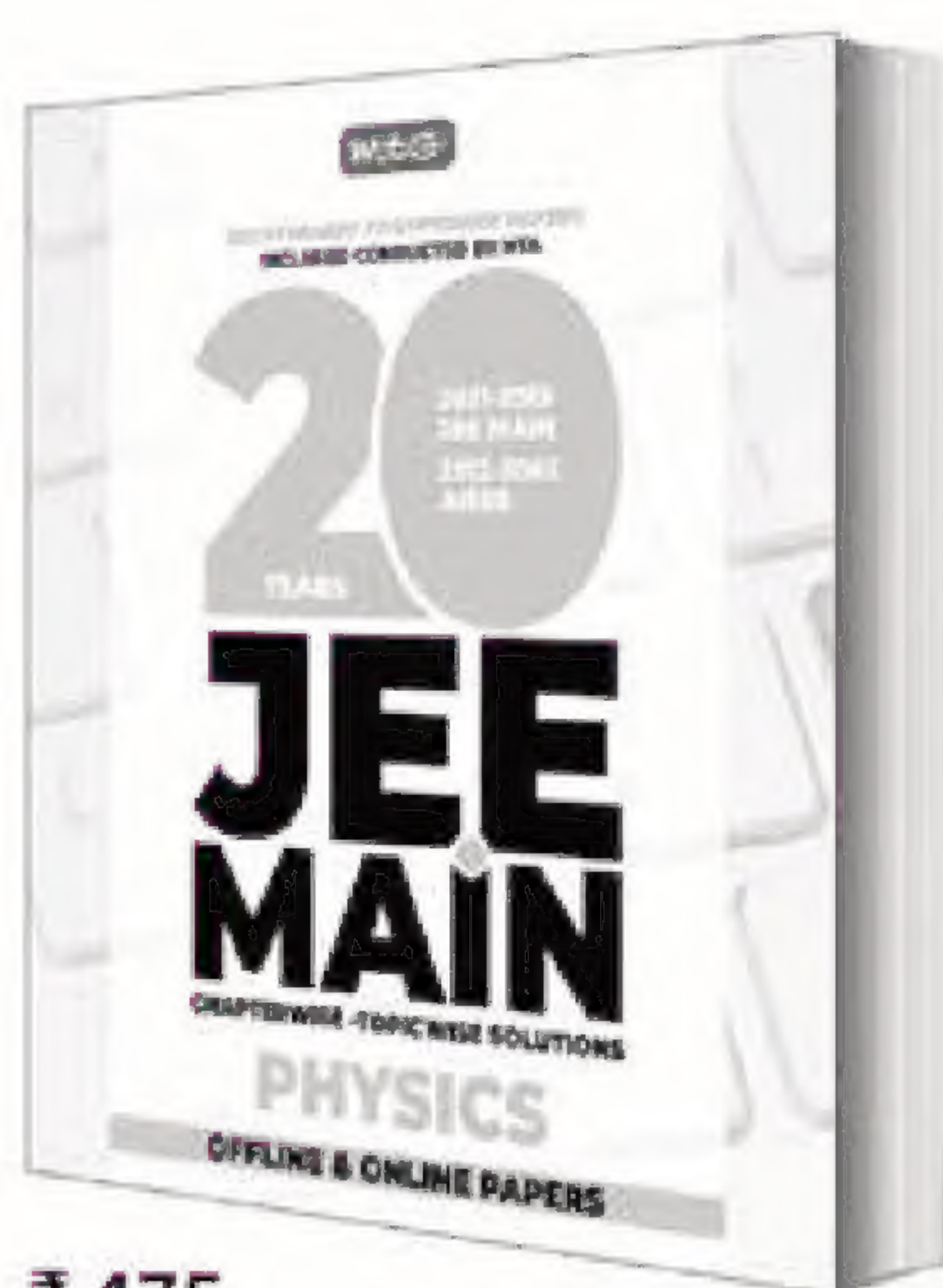
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PRACTICE PAPER 2022 JEE MAIN

Exam Dates

Session-1

20th to 29th June

Session-2

21st to 30th July

SECTION - A (MULTIPLE CHOICE QUESTIONS)

1. An element which belongs to 3rd period and 14th group, has electronic configuration

(a) $1s^2, 2s^2, 2p^6, 3s^2$
 (b) $1s^2, 2s^2, 2p^6, 3s^2, 3p^2$
 (c) $1s^2, 2s^2, 2p^6, 3s^2, 3p^3$
 (d) $1s^2, 2s^2, 2p^3$

2. For the reaction : $4\text{KClO}_3 \rightarrow 3\text{KClO}_4 + \text{KCl}$

$$\text{if } \frac{-d[\text{KClO}_3]}{dt} = k_1[\text{KClO}_3]^4$$

$$\frac{d[\text{KClO}_4]}{dt} = k_2[\text{KClO}_3]^4$$

$$\frac{d[\text{KCl}]}{dt} = k_3[\text{KClO}_3]^4, \text{ the correct relation between } k_1, k_2 \text{ and } k_3 \text{ is}$$

(a) $k_1 = k_2 = k_3$ (b) $4k_1 = 3k_2 = k_3$
 (c) $3k_1 = 4k_2 = 12k_3$ (d) none of these.

3. Xenon hexafluoride reacts with potassium fluoride to yield

(a) $[\text{XeF}_4]^{2+}[\text{KF}_3]^{2-}$ (b) XeF_4
 (c) $[\text{XeF}_5]^+[\text{KF}_2]^-$ (d) $\text{K}^+[\text{XeF}_7]^-$

4. [Y] is

(a) (b)
 (c) (d)

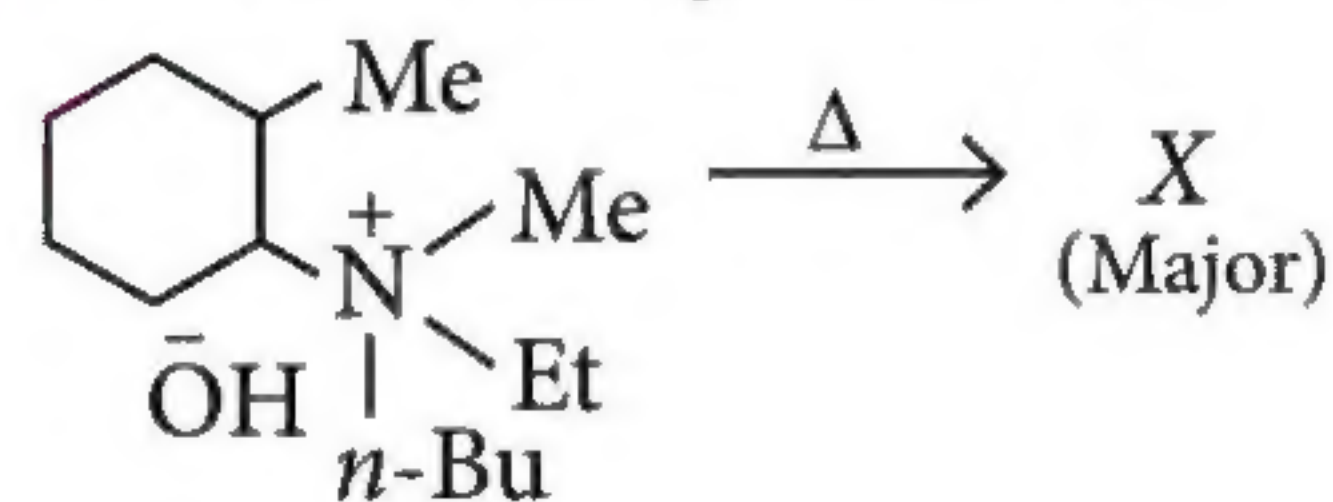
5. What quantity (in mL) of a 45% acid solution of a monoprotic strong acid must be mixed with a 20% solution of the same acid to produce 800 mL of a 29.875% acid solution?

(a) 320 (b) 325 (c) 316 (d) 330

6. Which of the following will give a pair of enantiomers?

(a) $[\text{Cr}(\text{NH}_3)_6][\text{Co}(\text{CN})_6]$
 (b) $[\text{Co}(\text{en})_2\text{Cl}_2]\text{Cl}$
 (c) $[\text{Pt}(\text{NH}_3)_4][\text{PtCl}_6]$
 (d) $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{NO}_2$
 ($\text{en} = \text{NH}_2\text{CH}_2\text{NH}_2$)

7. In the following reaction,



X is

(a) (b) $\text{CH}_2 = \text{CH}_2$
 (c) (d)

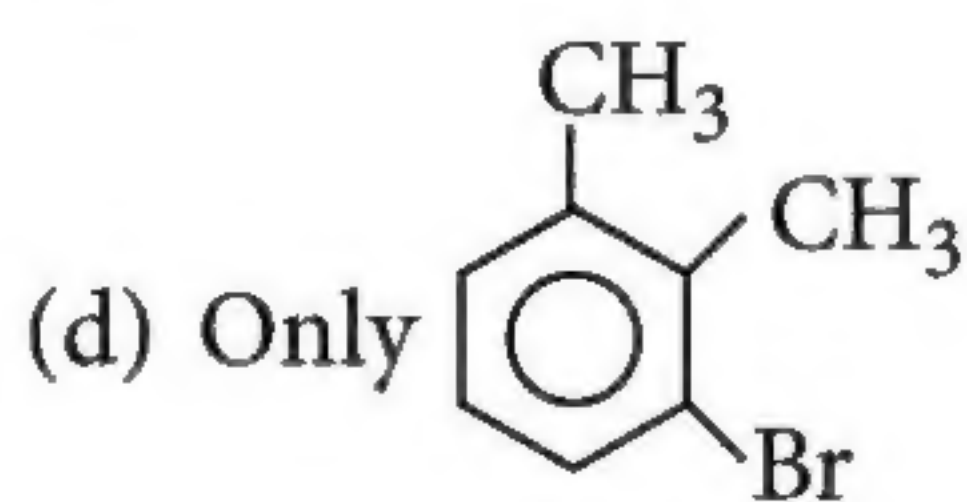
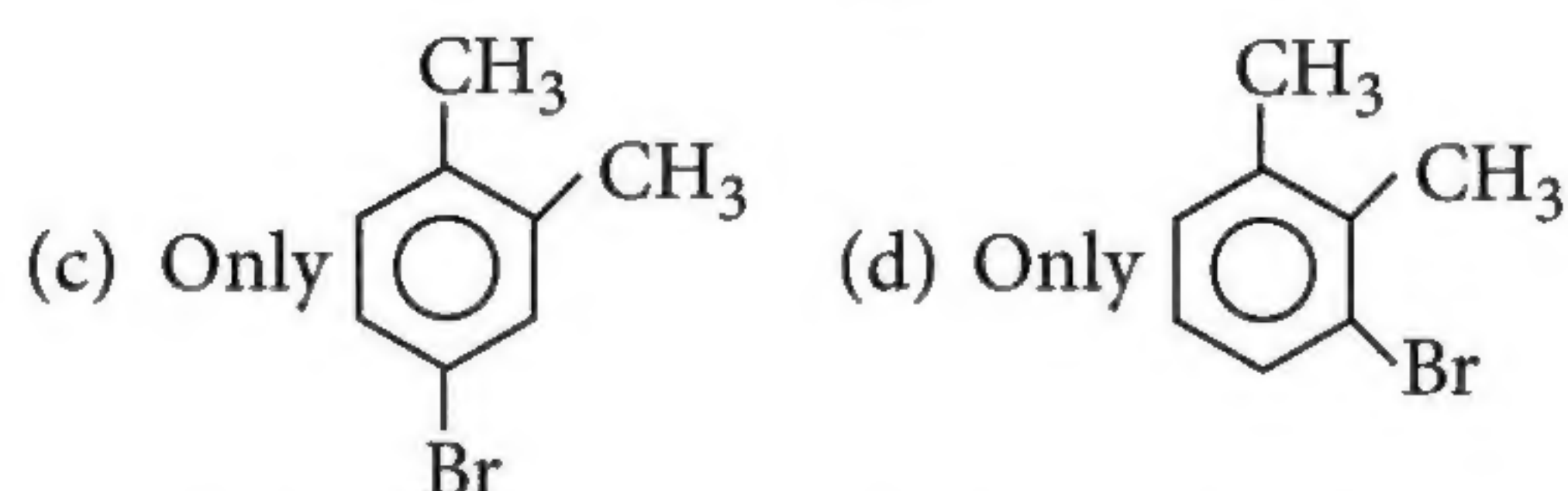
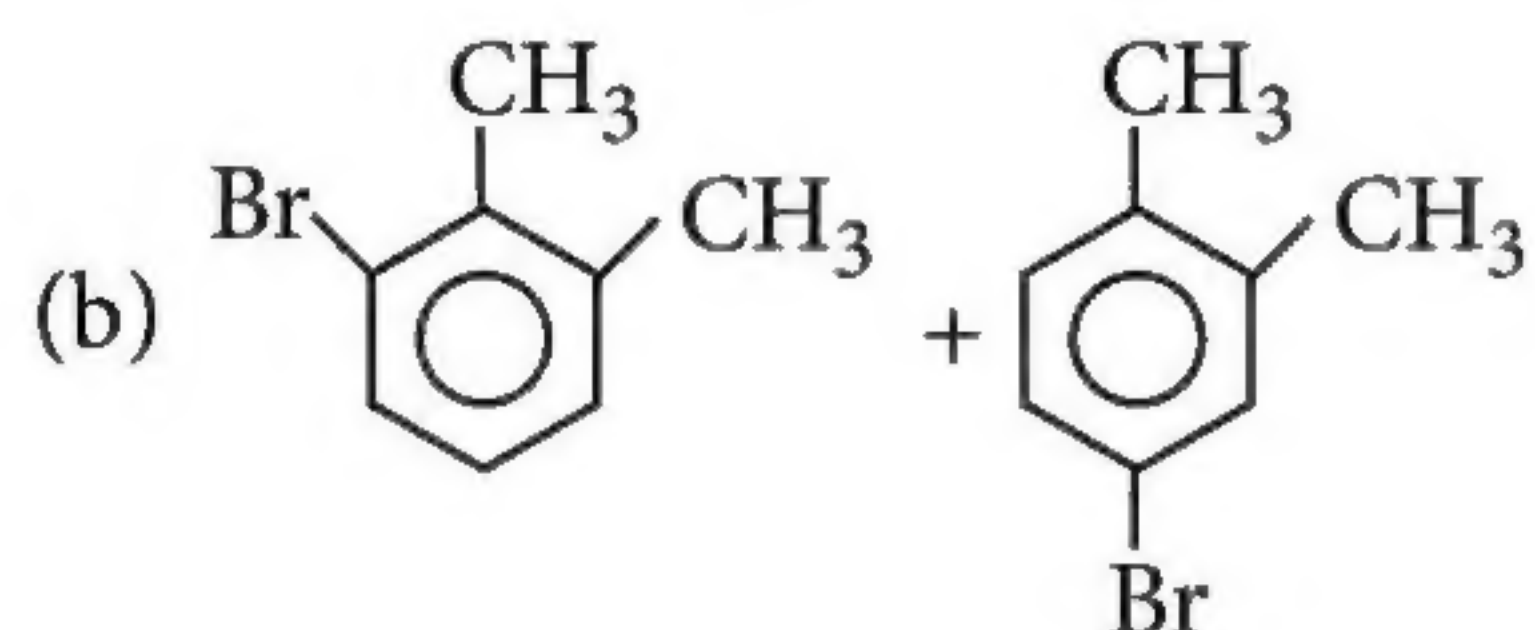
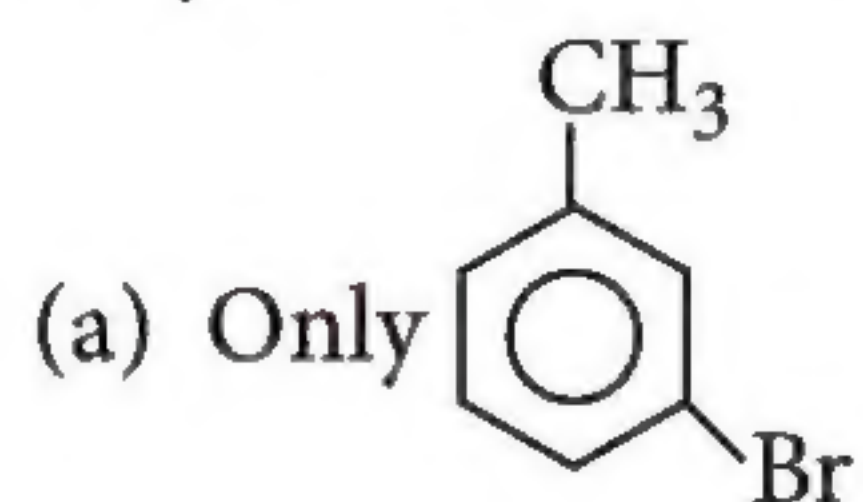
8. $\text{Al}_2(\text{SO}_4)_3 + \text{NH}_4\text{OH} \longrightarrow \text{X}$. X is

(a) a white gelatinous precipitate soluble in excess of NaOH
 (b) green precipitate insoluble in excess of NH_4OH
 (c) white precipitate insoluble in excess of NaOH
 (d) not a precipitate.

9. Photoelectric emission is observed from a metal surface with incident frequencies ν_1 and ν_2 , where $\nu_1 > \nu_2$. If the kinetic energies of the photoelectrons emitted in the two cases are in the ratio 2 : 1, then the threshold frequency ν_0 of the metal is

(a) $\nu_1 - \nu_2$ (b) $\frac{\nu_1 - \nu_2}{h}$
 (c) $2\nu_1 - \nu_2$ (d) $2\nu_2 - \nu_1$

10. Which of the following products is obtained when *o*-xylene is treated with Br₂ in the presence of iron?



11. 4 g of graphite is burnt in a bomb calorimeter of heat capacity of 30 kJ K⁻¹ in excess of oxygen at 1 atmospheric pressure. The temperature rises from 300 K to 304 K. What is the enthalpy of combustion of graphite (in kJ mol⁻¹)?

- (a) 360 (b) 1440
(c) -360 (d) -1440

12. Which of the following statement(s) is/are correct?

(I) The size of the lanthanide M³⁺ ions decreases as the atomic number of M increases.

(II) Lanthanoids show limited number of oxidation states.

(III) Like transition metals, coordination number six is very common in lanthanide complexes.

- (a) I only (b) I and II only
(c) I and III only (d) III only

13. Which of the following causes damage to the buildings containing calcium carbonate and is responsible for cough and choking in human beings?

- (a) Sulphur (b) Carbon
(c) Nitrogen dioxide (d) Sulphur dioxide

14. 5 g mixture of FeSO₄·7H₂O and Fe₂(SO₄)₃·9H₂O is completely oxidised by 5.5 mL of 0.1 M KMnO₄ in acidic medium. The percentage of FeSO₄·7H₂O in mixture is

- (a) 15.29 (b) 30.58
(c) 20.24 (d) 25.29

15. If the salt M₂X, QY₂ and PZ₃ have the same solubilities, their K_{sp} values are related as

(a) $K_{sp}(M_2X) = K_{sp}(QY_2) < K_{sp}(PZ_3)$

(b) $K_{sp}(M_2X) > K_{sp}(QY_2) = K_{sp}(PZ_3)$

(c) $K_{sp}(M_2X) < K_{sp}(QY_2) = K_{sp}(PZ_3)$

(d) $K_{sp}(M_2X) > K_{sp}(QY_2) > K_{sp}(PZ_3)$

16. Roasted copper pyrite on smelting with sand produces

- (a) FeSiO₃ as fusible slag and Cu₂S as matte
(b) CaSiO₃ as infusible slag and Cu₂O as matte
(c) Ca₃(PO₄)₂ as fusible slag and Cu₂S as matte
(d) Fe₃(PO₄)₂ as infusible slag and Cu₂S as matte.

17. The sweetest artificial sugar among the following is

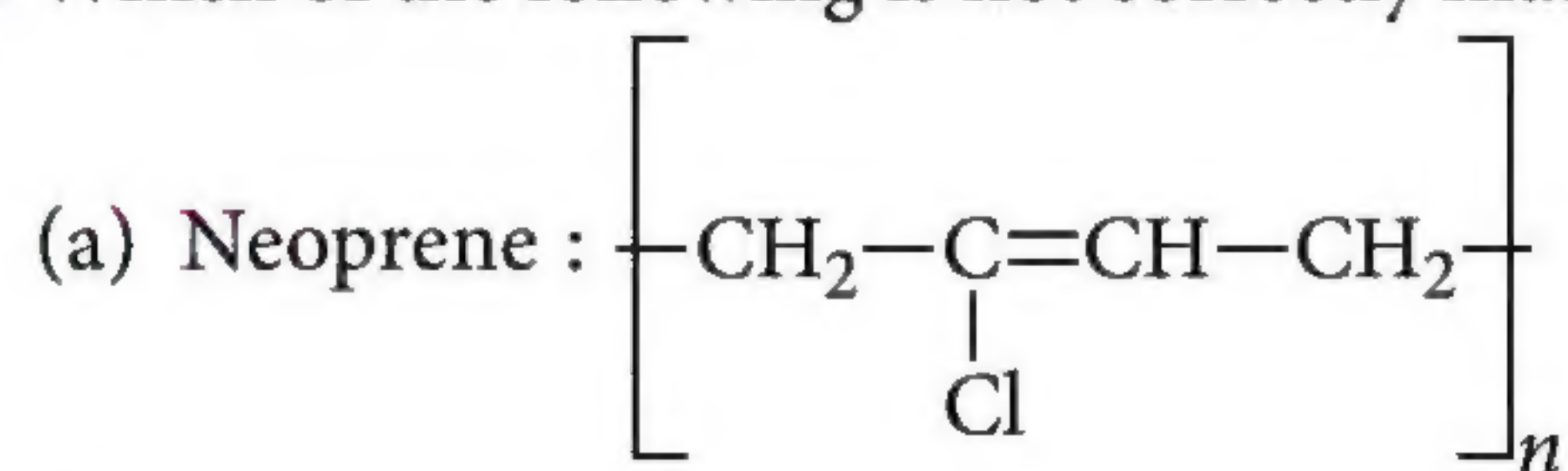
- (a) aspartame (b) sucralose
(c) alitame (d) sucrose.

18. A suspension of inorganic salt X when saturated with ammonia and carbon dioxide forms ammonium sulphate, a nitrogenous fertiliser. A gas Z and a solid is produced when it is heated at very high temperature. Gas Z produces white turbidity in aqueous solution and produces green colour with Cr₂O₇²⁻ solution in acidic medium.

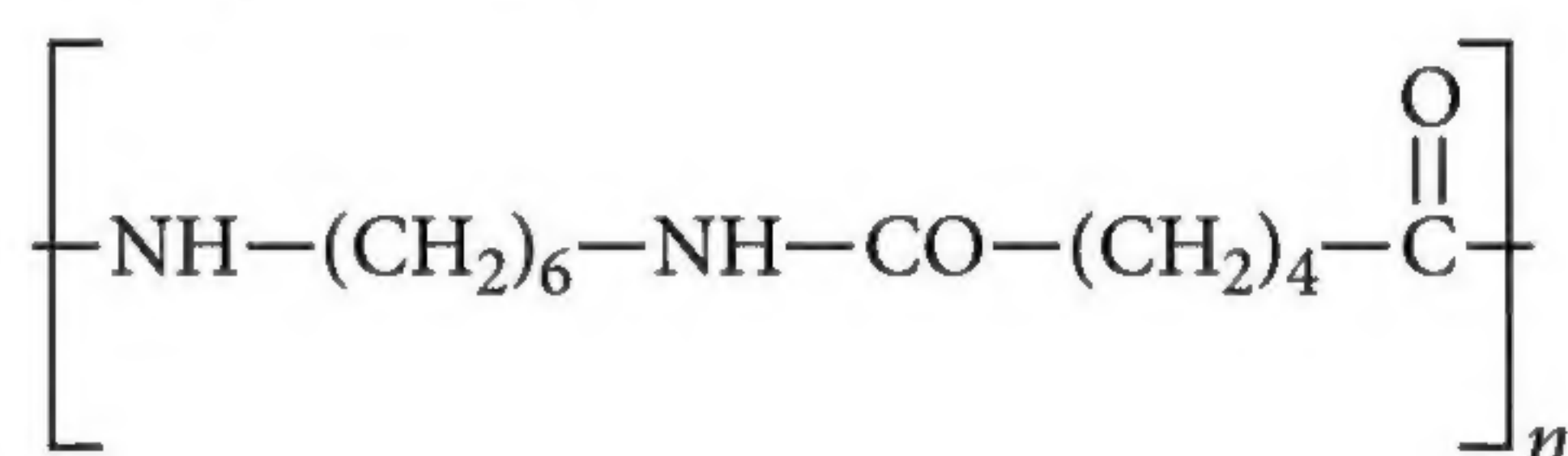
Inorganic salt X is

- (a) MgSO₄·7H₂O (b) CaSO₄·2H₂O
(c) Na₂SO₄·10H₂O (d) CaCO₃

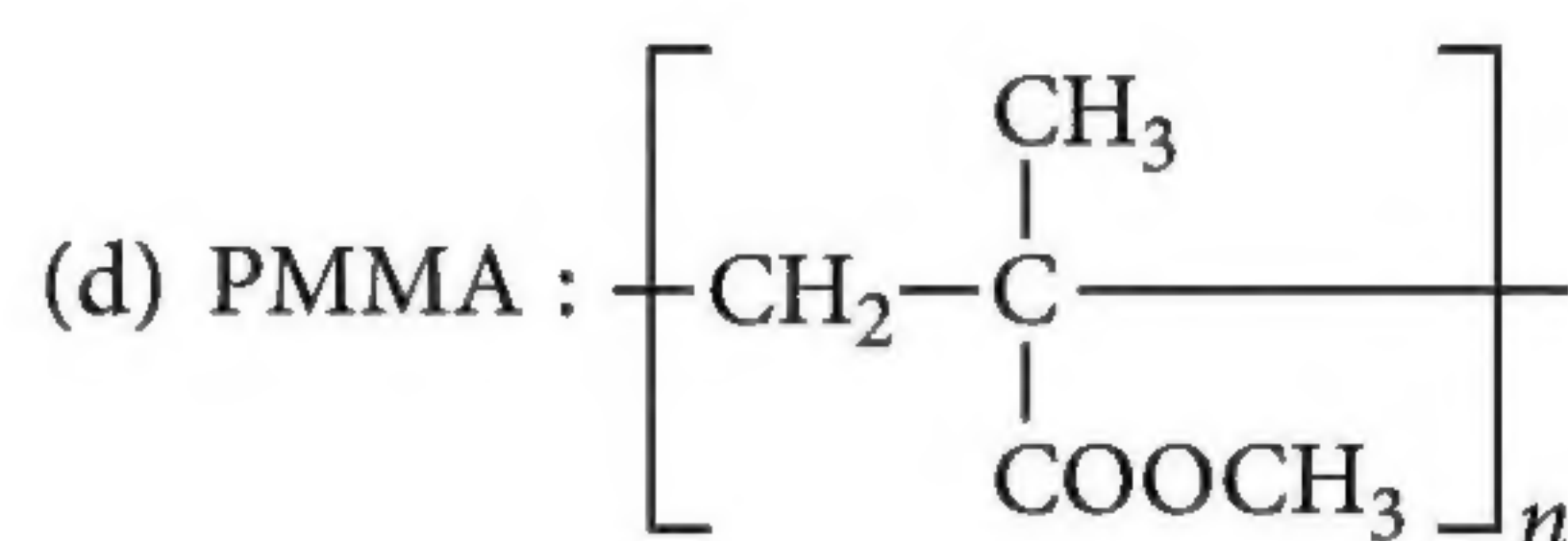
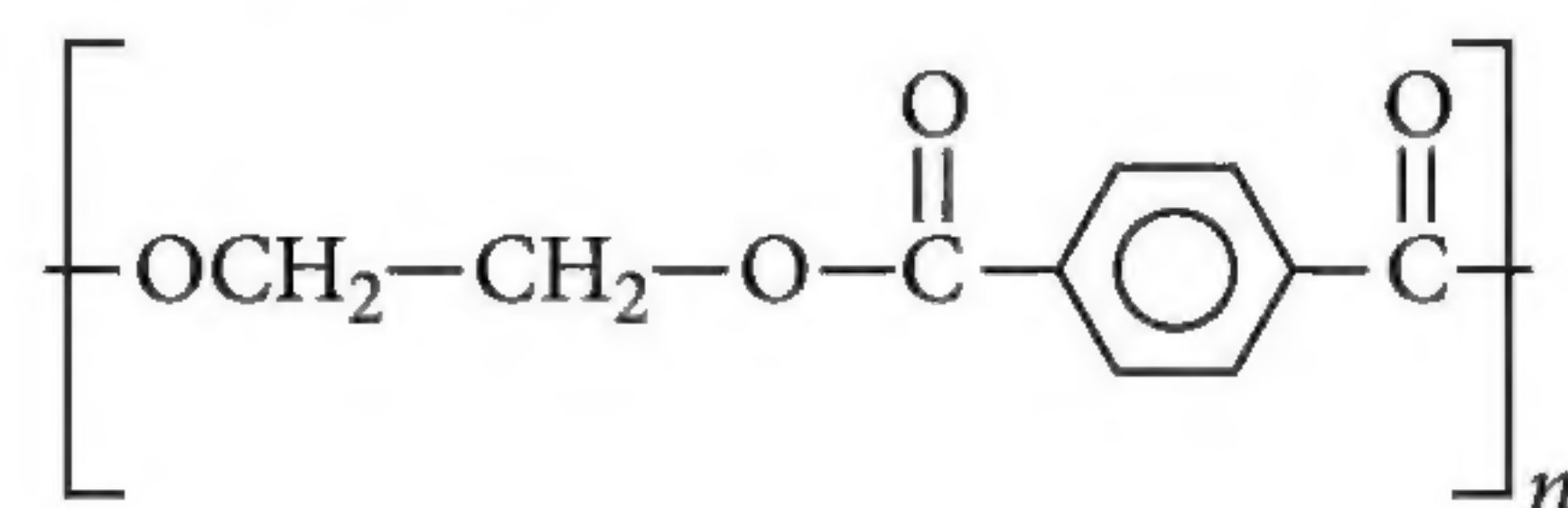
19. Which of the following is not correctly matched?



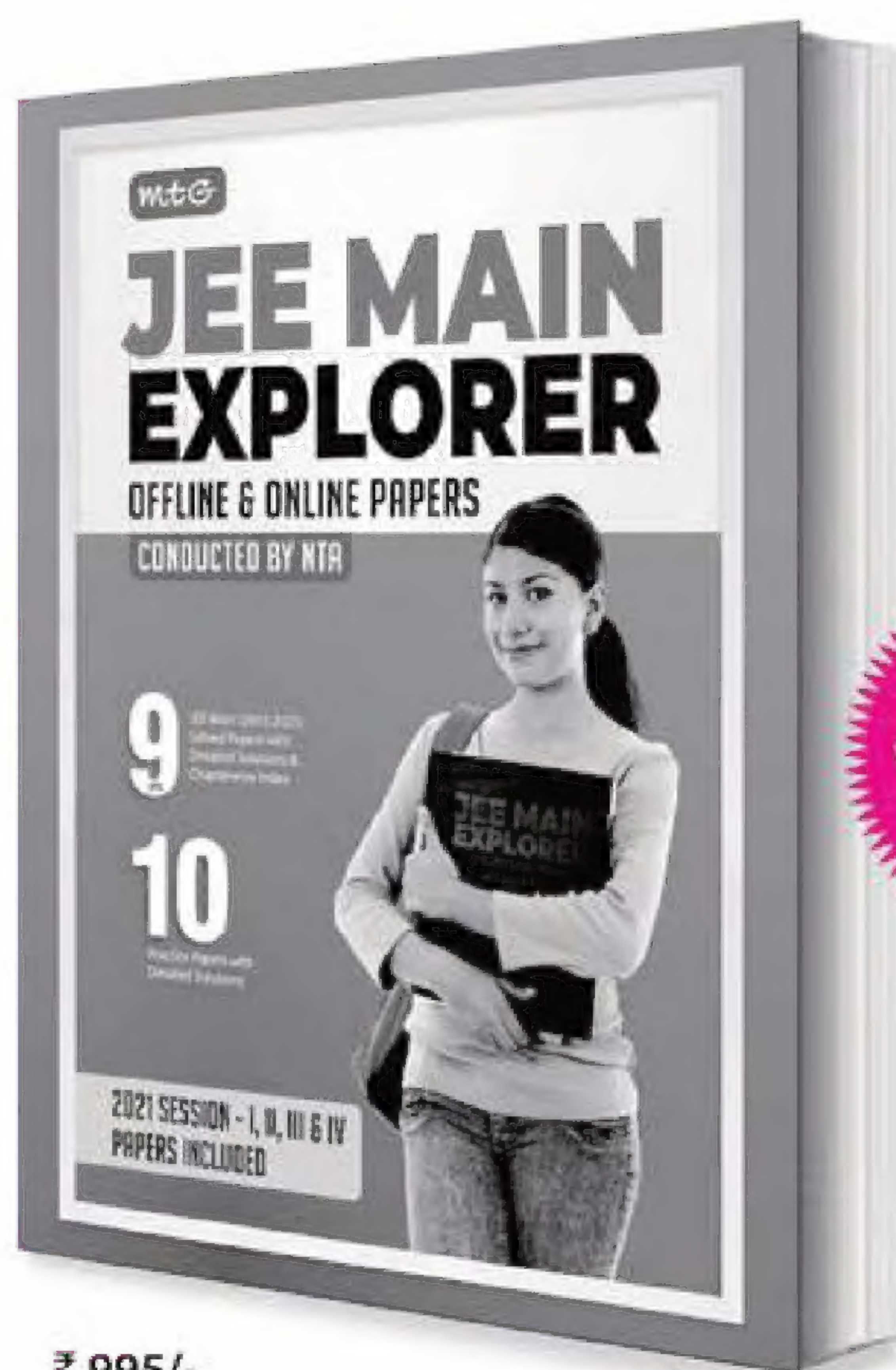
(b) Nylon-6,6 :



(c) Terylene :



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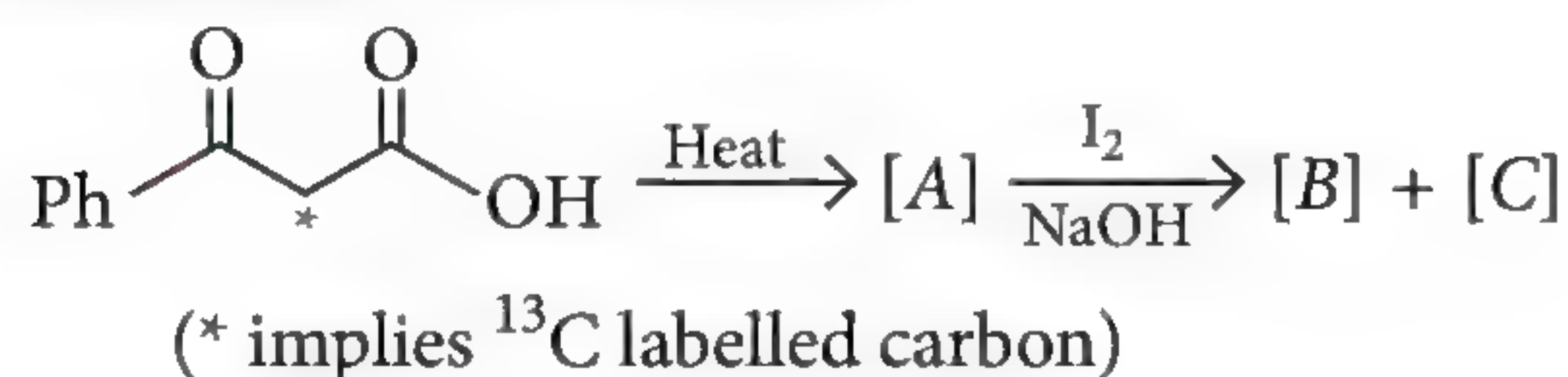


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20. In the following reaction sequence, the correct structures of A, B and C are

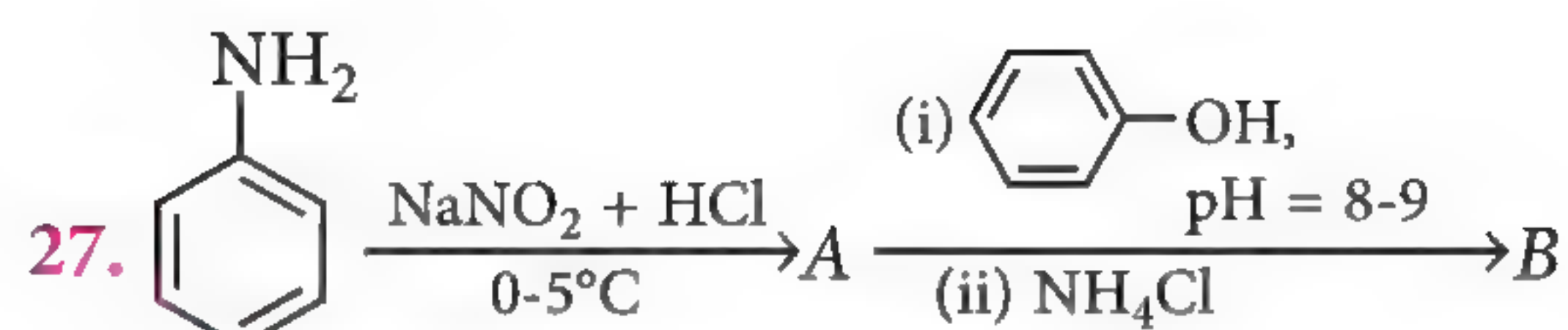


- (a) $\text{A} = \text{Ph}-\overset{\text{O}}{\parallel}\text{C}-\overset{*}{\text{CH}}_3$ $\text{B} = \text{Ph}-\overset{\text{O}}{\parallel}\text{C}-\overset{*}{\text{O}}\text{Na}^+$ $\text{C} = \text{CHI}_3$
- (b) $\text{A} = \text{Ph}-\overset{\text{O}}{\parallel}\text{C}-\overset{*}{\text{CH}}_3$ $\text{B} = \text{Ph}-\overset{\text{O}}{\parallel}\text{C}-\overset{*}{\text{O}}\text{Na}^+$ $\text{C} = \text{CHI}_3$
- (c) $\text{A} = \text{Ph}-\overset{\text{O}}{\parallel}\text{C}-\overset{*}{\text{CH}}_3$ $\text{B} = \text{Ph}-\overset{\text{O}}{\parallel}\text{C}-\overset{*}{\text{O}}\text{Na}^+$ $\text{C} = \overset{*}{\text{C}}\text{HI}_3$
- (d) $\text{A} = \text{Ph}-\overset{\text{O}}{\parallel}\text{C}-\overset{*}{\text{CH}}_3$ $\text{B} = \text{Ph}-\overset{\text{O}}{\parallel}\text{C}-\overset{*}{\text{O}}\text{Na}^+$ $\text{C} = \overset{*}{\text{C}}\text{H}_3\text{I}$

SECTION - B (NUMERICAL TYPE QUESTIONS)

Attempt any 5 questions out of 10.

21. The electrolysis of a metal salt solution was carried out by passing a current of 4 amperes for 45 minutes. It results in deposition of 2.977 g of a metal. If atomic mass of the metal is 106.4 g mol^{-1} . Calculate the charge on the metal cation.
22. How many carbon atoms are present in parent carbon chain of following compound?
23. Calculate the amount of sodium chloride (in g) which must be added to 1000 mL of water so that its freezing point is depressed by 0.744 K. For water, $K_f = 1.86 \text{ K/m}$. Assume density of water to be 1 g mL^{-1} .
24. Calculate the total pressure (in atm) in a 10.0 L cylinder which contains 0.4 g helium, 1.6 g oxygen and 1.4 g nitrogen at 27°C .
25. How many of the following ethers cannot be prepared by Williamson's synthesis?
 $\text{CH}_3\text{OCH}_2\text{CH}_3$, $\text{C}_6\text{H}_5\text{OCH}_3$, $\text{C}_6\text{H}_5\text{OCH}_2\text{CH}_3$, $(\text{C}_6\text{H}_5)_2\text{O}$, $(\text{CH}_3)_3\text{COCH}_3$, $(\text{CH}_3)_3\text{COCH}_2\text{CH}_3$, $(\text{CH}_3)_3\text{COC}(\text{CH}_3)_3$, $(\text{C}_2\text{H}_5)_2\text{O}$, $\text{C}_6\text{H}_5\text{CH}_2\text{OC}_6\text{H}_5$
26. A decapeptide (mol. wt. = 796) on complete hydrolysis gives glycine (mol. wt. = 75), alanine and phenylalanine. Glycine contributes 47.0% to the total weight of the hydrolysed products. The number of glycine units present in decapeptide is



If molar mass of compound B is x , then find the value of $x/2$.

28. How many of the following are interstitial hydrides.
 $\text{NaH}_{2.9}$, $\text{LaH}_{2.87}$, $\text{BeH}_{3.5}$, $\text{TiH}_{1.5}$, $\text{ZrH}_{1.3}$, B_2H_6 , CH_4
29. The edge length of unit cell of a metal having molecular weight 75 g/mol is 5 \AA which crystallises in cubic lattice. If the density is 2 g/cc then find the radius of metal atom ($N_A = 6 \times 10^{23}$). Give the answer in pm.
30. A compound X, of boron reacts with NH_3 on heating to give another compound Y which is called inorganic benzene. What is the sum of total B-atoms present in X and Y?

SOLUTIONS

1. (b): $\text{Si} : 1s^2, 2s^2 2p^6, 3s^2 3p^2$

2. (c): $\text{Rate} = -\frac{1}{4} \frac{d[\text{KClO}_3]}{dt} = \frac{1}{3} \frac{d[\text{KClO}_4]}{dt} = \frac{d[\text{KCl}]}{dt}$

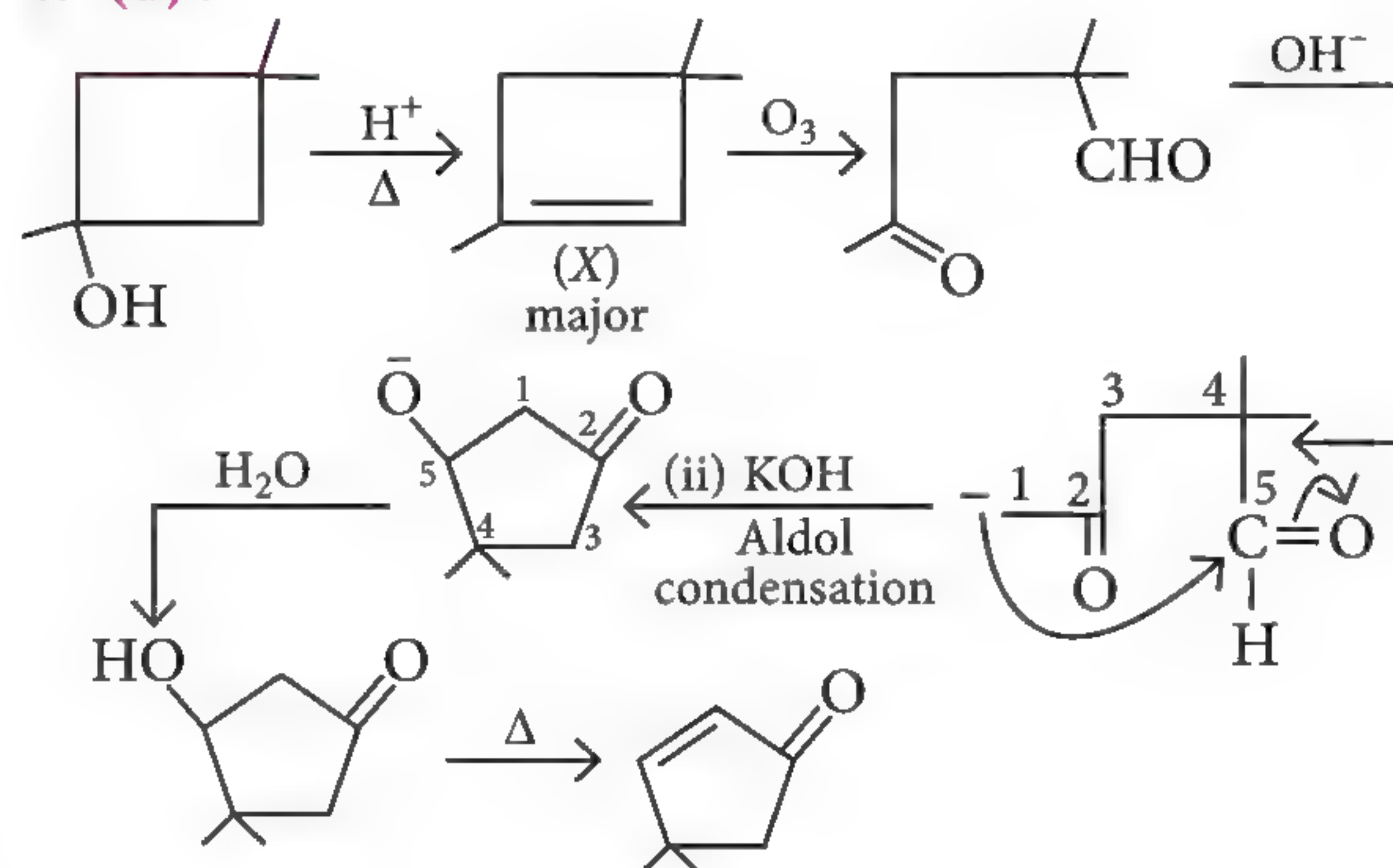
$\therefore \frac{k_1}{4} [\text{KClO}_3]^4 = \frac{k_2}{3} [\text{KClO}_3]^4 = k_3 [\text{KClO}_3]^4$

$\therefore 3k_1 = 4k_2 = 12k_3$

3. (d): XeF_6 in presence of KF behaves as F^- acceptor to form fluoro-anion.



4. (d):

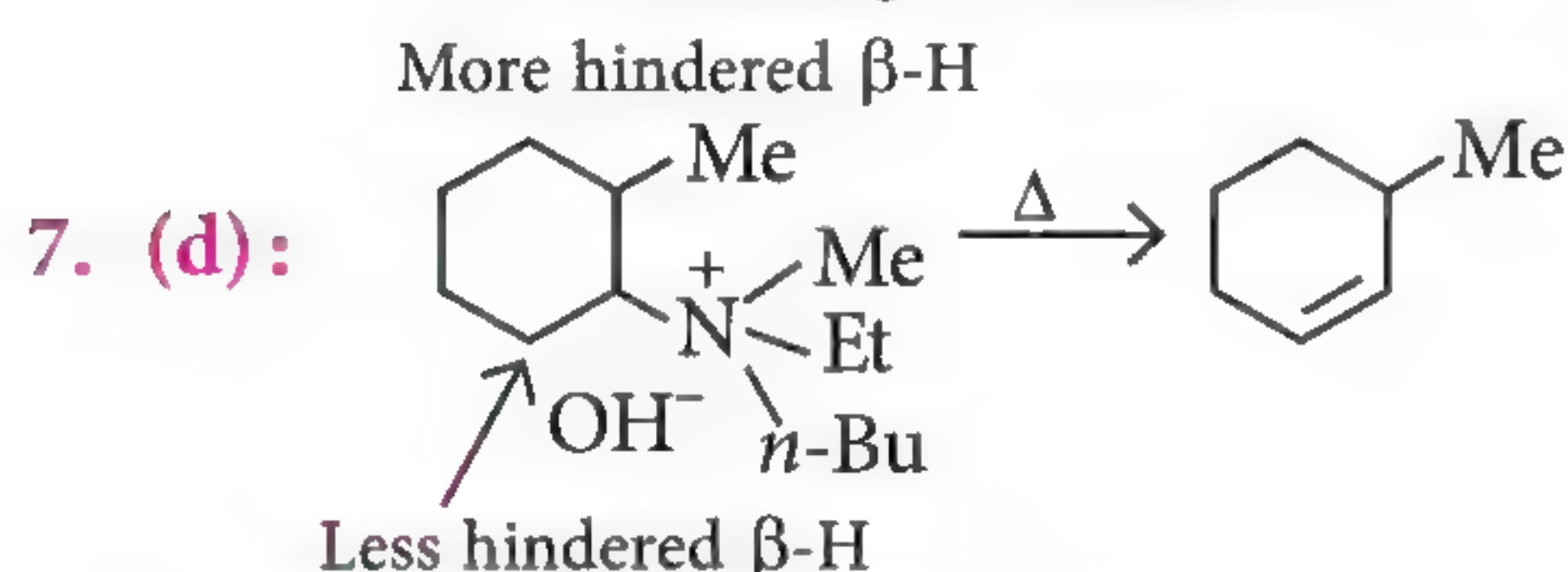
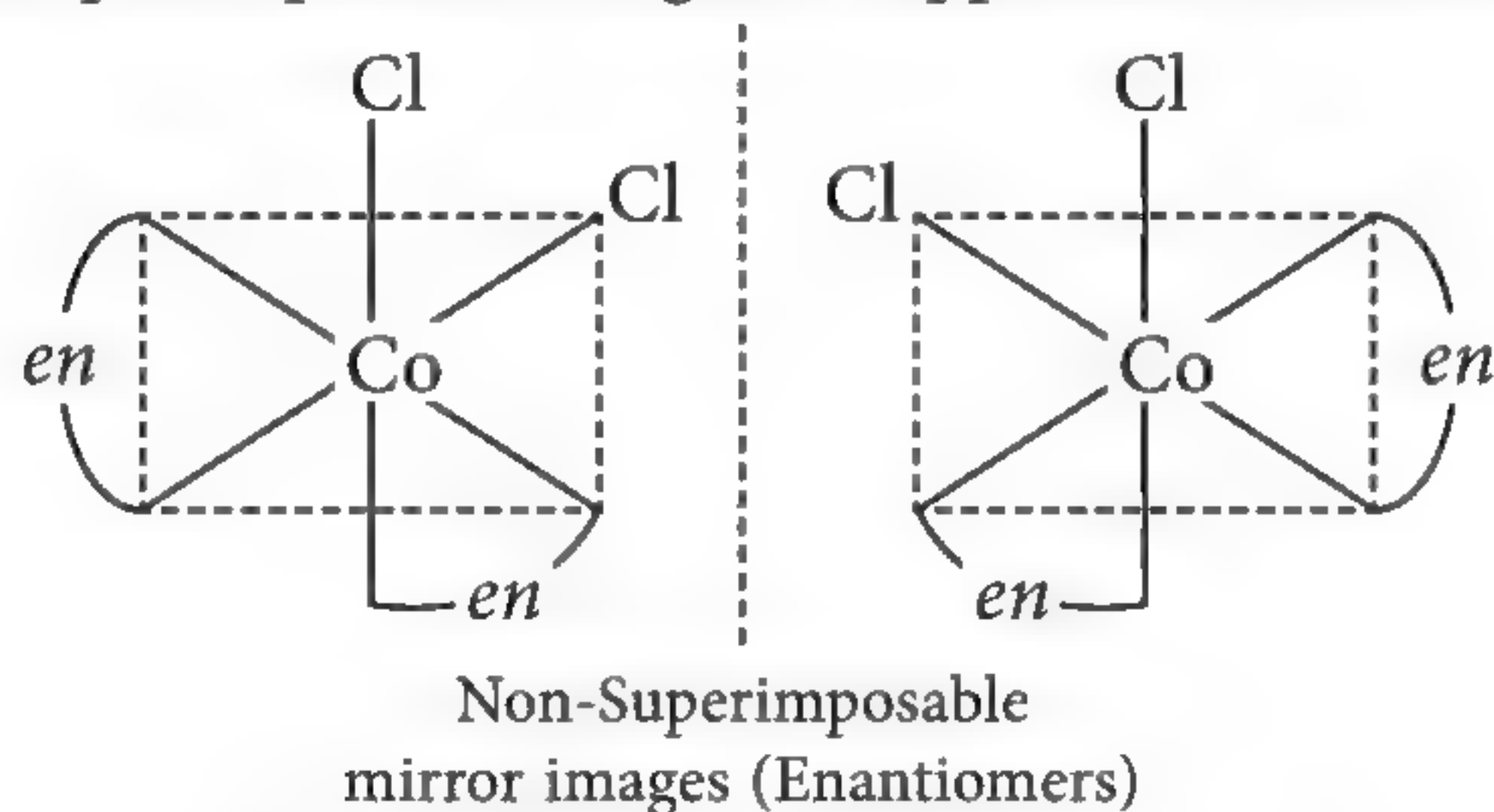


5. (c): By equating moles of mixture

$$\frac{V \times 45}{100} + \frac{(800 - V) \times 20}{100} = \frac{800 \times 29.875}{100}$$

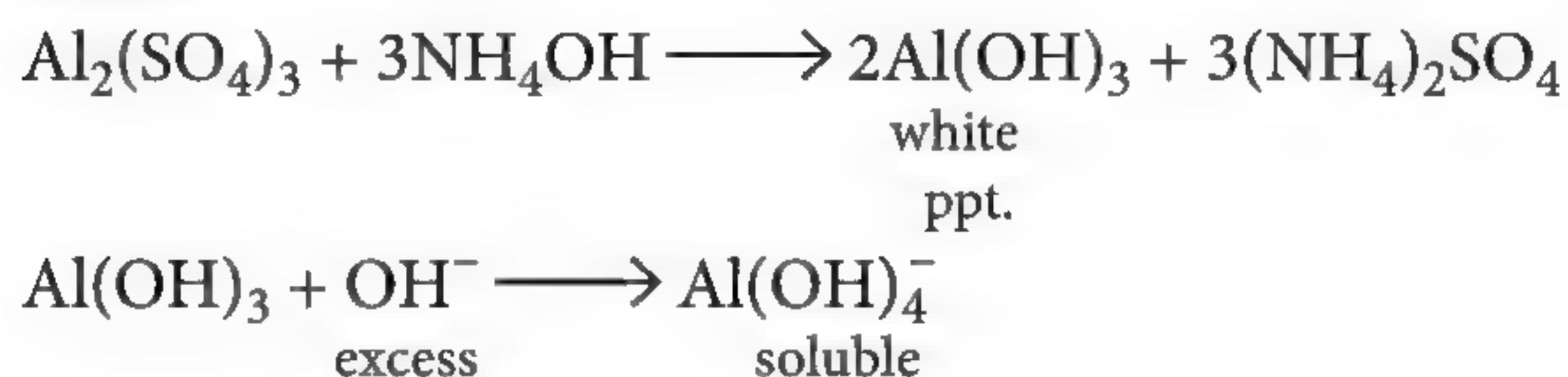
$$\therefore \frac{9V}{20} + 160 - \frac{V}{5} = 239 \Rightarrow V = 316 \text{ mL}$$

6. (b): Non superimposable mirror images are called optical isomers. They are also called enantiomers and rotate plane polarised light in opposite directions.



In Hofmann elimination reaction, less sterically hindered β -hydrogen is removed and less substituted alkene is the major product.

8. (a): $\text{Al}_2(\text{SO}_4)_3$ reacts with NH_4OH to form a white gelatinous precipitate which is soluble in excess of NaOH .



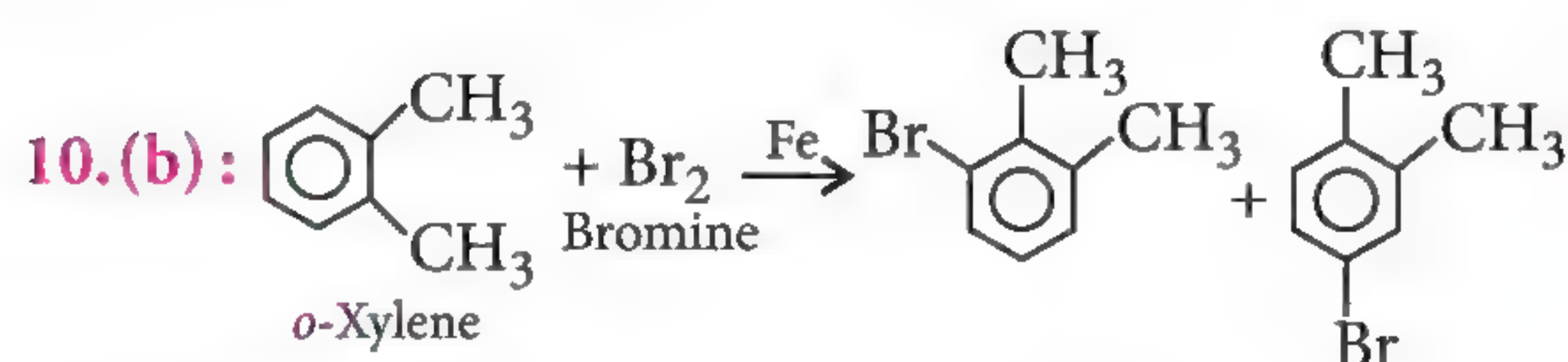
9. (d): $h\nu_1 = h\nu_0 + K.E.$... (i)

$h\nu_2 = h\nu_0 + \frac{1}{2} K.E.$ or $2h\nu_2 = 2h\nu_0 + K.E.$... (ii)

Subtracting eqn. (ii) from eqn. (i) gives ;

$$h\nu_1 - 2h\nu_2 = h\nu_0 - 2h\nu_0$$

$$\text{or } \nu_1 - 2\nu_2 = -\nu_0 \text{ or } \nu_0 = 2\nu_2 - \nu_1$$



11. (c): $q = C \times \Delta t = 30 \times 4 = 120 \text{ kJ}$

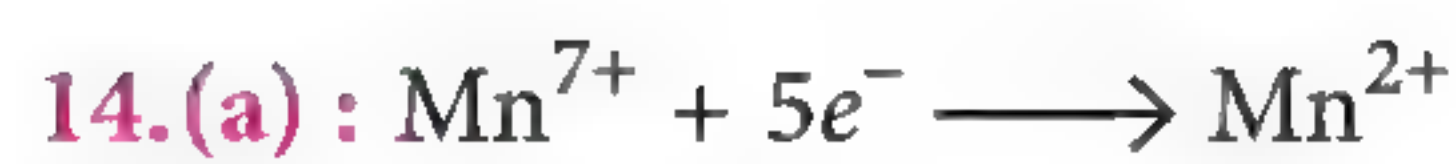
Enthalpy of combustion of 4 g of graphite = -120 kJ

Enthalpy of combustion of 1 mole of graphite

$$= -\frac{12}{4} \times 120 = -360 \text{ kJ mol}^{-1}$$

12. (b)

13. (d): SO_2 (sulphur dioxide) in air and moisture gives H_2SO_4 which reacts with marble (calcium carbonate) and causes damage to buildings. Also it causes cough and choking in human beings.



$$\text{Meq. of KMnO}_4 = \text{Meq. of FeSO}_4 \cdot 7\text{H}_2\text{O}$$

$$5.5 \times 0.1 \times 5 = \frac{w}{278} \times 1000$$

$$\therefore w = 0.7645$$

$$\therefore \% \text{ of FeSO}_4 \cdot 7\text{H}_2\text{O} = \frac{0.7645}{5} \times 100 = 15.29\%$$

15. (a): For the solubility of a salt like A_xB_y



If s is the solubility

$$[\text{A}^{y+}] = xs, [\text{B}^{x-}] = ys$$

$$K_{sp} = (xs)^x \cdot (ys)^y = x^x y^y s^{x+y}$$

$$\text{For } \text{M}_2\text{X} (x=2, y=1); K_{sp} = 4s^3$$

$$\text{QY}_2 (x=1, y=2); K_{sp} = 4s^3$$

$$\text{PZ}_3 (x=1, y=3); K_{sp} = 27s^4$$

16. (a): During smelting, silica combines with FeO to form fusible FeSiO_3 slag and Cu_2S as matte.

17. (c): Aspartame is 100 times sweeter than sucrose. Sucralose is 600 times sweeter than sucrose.

Alitame is 2000 times sweeter than sucrose.

18. (b)

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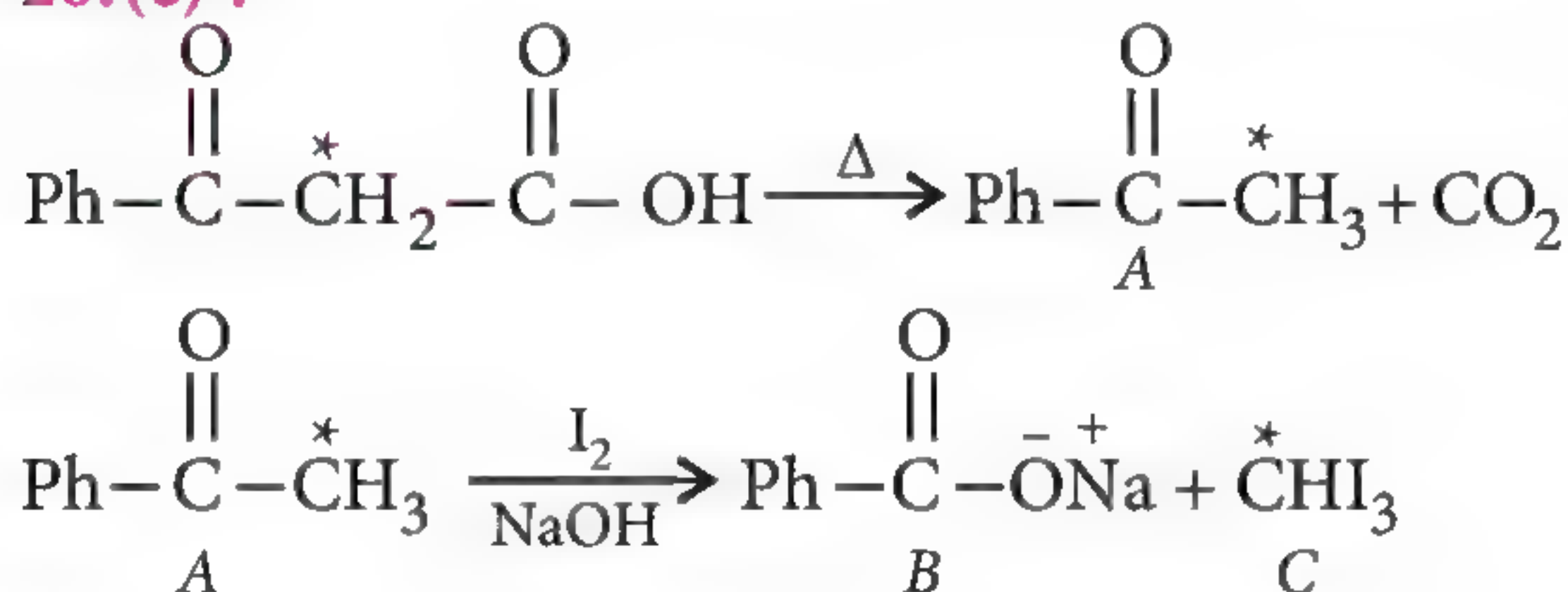
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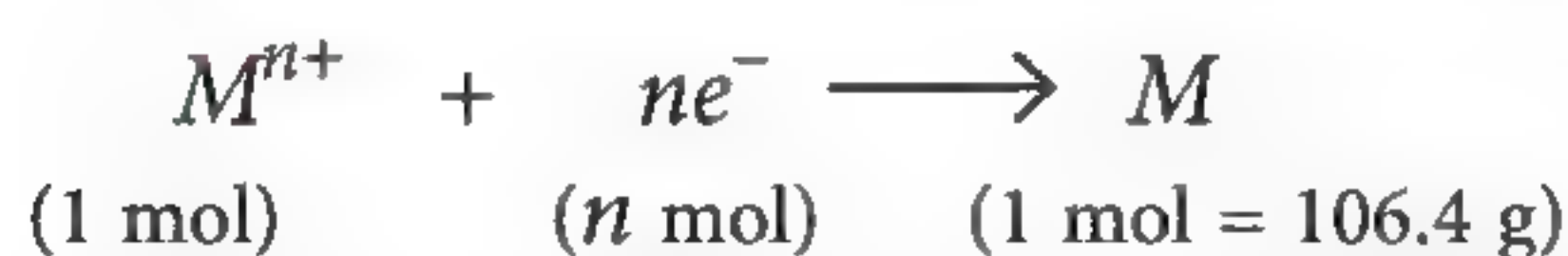
19.(b) : Nylon-6,6 is a polyamide hence, it has only — CONH — linkage and no — COO — linkage.

20.(c) :



21.(4) : Let the charge on the metal ion be n^+ .

\therefore The reduction half-reaction would be



Quantity of electricity required for depositing 106.4 g of metal = $n \times 96500 \text{ C}$

Quantity of electricity required for depositing 2.977 g of

$$\text{metal} = \frac{n \times 96500 \times 2.977}{106.4} = n \times 2700 \text{ C}$$

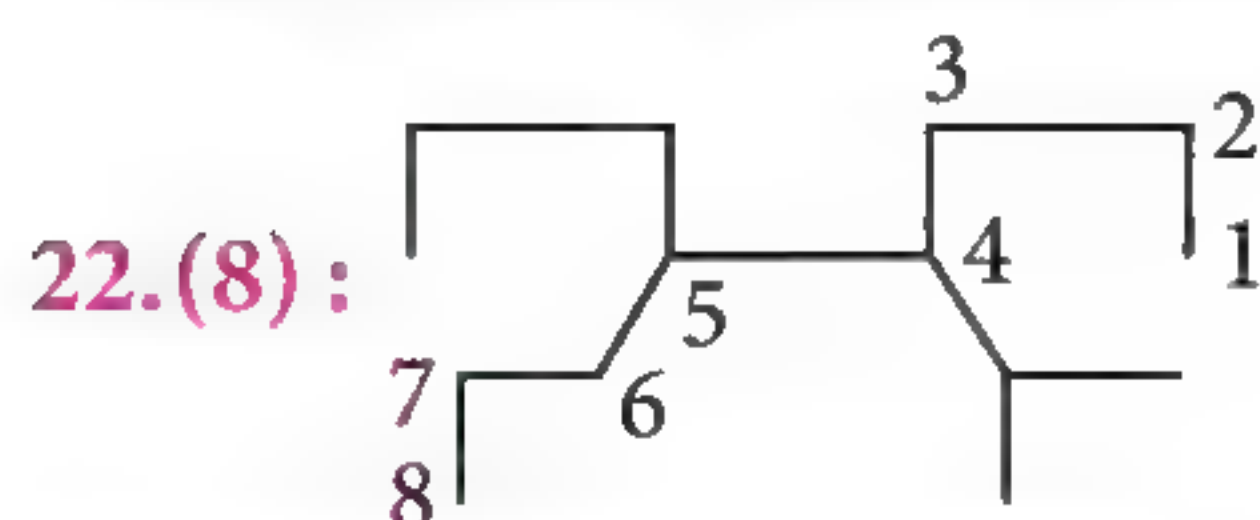
Quantity of electricity actually passed

$$= 4 \times 45 \times 60 = 10800 \text{ C}$$

Now, $10800 = n \times 2700$

$$\therefore n = \frac{10800}{2700} = 4$$

Hence, charge on metal ion = + 4



23.(11.7) : Mass of NaCl, $w_2 = ?$, Volume of water = 1000 mL,

$\Delta T_f = 0.744 \text{ K}$, Density of water = 1 g mL^{-1}

So, mass of water $w_1 = 1000 \text{ mL} \times 1 \text{ g mL}^{-1}$
= 1000 g = 1 kg

$$\Delta T_f = iK_f m = iK_f \times \frac{(w_2/58.5)}{w_1} = \frac{iK_f w_2}{58.5 \times w_1}$$

$$w_2 = \frac{\Delta T_f \times 58.5 \times w_1}{i \times K_f} = \frac{0.744 \times 58.5 \times 1}{2 \times 1.86} = 11.7 \text{ g}$$

($\because i$ for NaCl = 2)

So, Mass of NaCl required = 11.7 g

24.(0.49) : Given $T = 27^\circ\text{C} = 27 + 273 = 300 \text{ K}$

$V = 10.0 \text{ L}$

Mass of He = 0.4 g

Mass of oxygen = 1.6 g

Mass of nitrogen = 1.4 g

$n_{\text{He}} = 0.4/4 = 0.1$

$n_{\text{O}_2} = 1.6/32 = 0.05$

$n_{\text{N}_2} = 1.4/28 = 0.05$

$n_{\text{total}} = n_{\text{He}} + n_{\text{O}_2} + n_{\text{N}_2} = 0.1 + 0.05 + 0.05 = 0.2$

$$P = \frac{nRT}{V} = \frac{0.2 \times 0.082 \times 300}{10} = 0.49 \text{ atm}$$

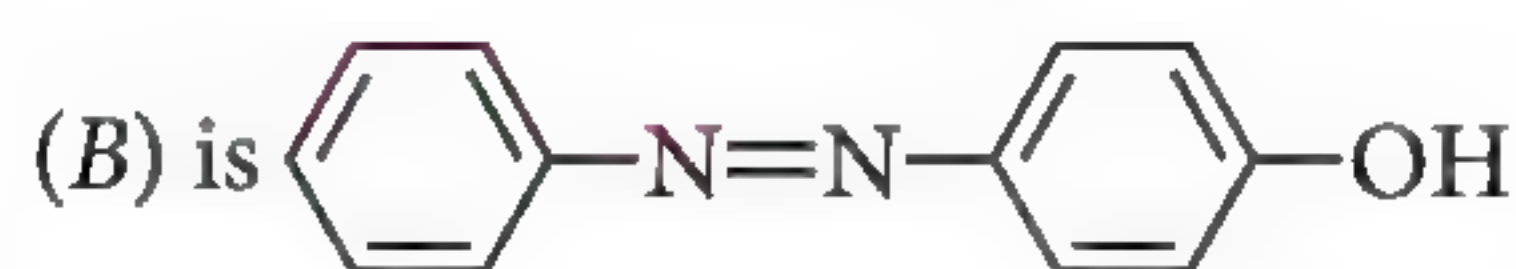
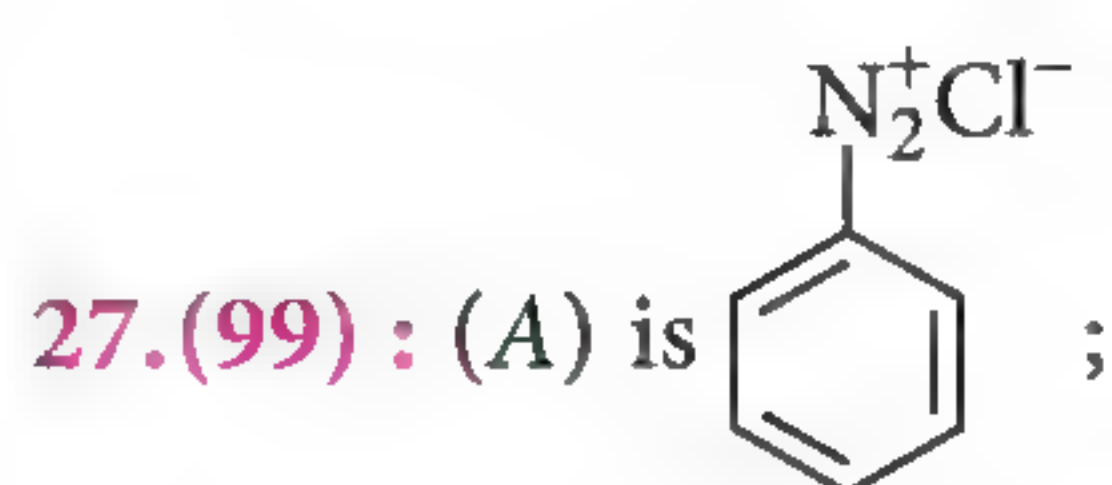
25.(2) : Williamson's synthesis requires that the alkyl halide should be 1° and alkoxide ion may be 1° , 2° or 3° . Thus, two ethers which cannot be prepared by Williamson's synthesis are

$(\text{C}_6\text{H}_5)_2\text{O}$, $(\text{CH}_3)_3\text{COC}(\text{CH}_3)_3$

26.(6) : $\text{Decapeptide} + 9\text{H}_2\text{O} \longrightarrow \text{Glycine} + \text{Alanine} + \text{Phenylalanine}$

Total weight of amino acids after addition of 9 moles of $\text{H}_2\text{O} = 796 + (9 \times 18) = 958$

For n units of glycine, $\frac{n \times 75}{958} \times 100 = 47 \Rightarrow n = 6$



Molar mass of B is 198.

$\therefore x = 198$

$$\frac{x}{2} = \frac{198}{2} = 99$$

28.(3) : Interstitial hydrides are generally formed by d -block and f -block elements. $\text{LaH}_{2.87}$, $\text{TiH}_{1.5}$ and $\text{ZrH}_{1.3}$ are the examples of interstitial hydrides.

$$\text{29.(216) : } \rho = \frac{Z \times M}{N_A V}$$

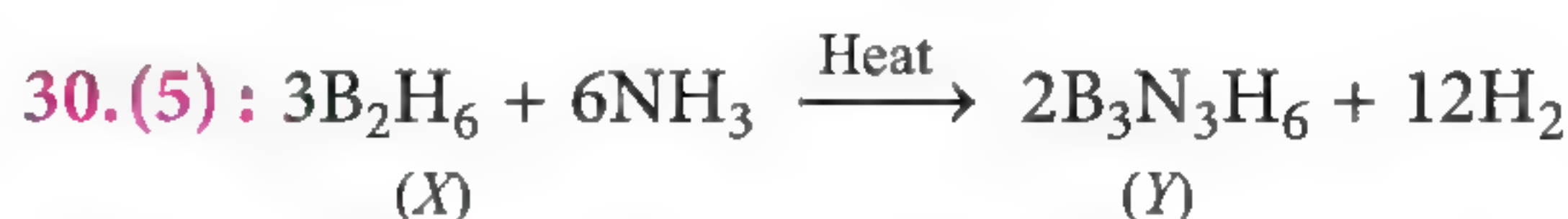
$$Z = \frac{\rho N_A V}{M} = \frac{2 \times 6 \times 10^{23} \times (5 \times 10^{-8})^3}{75}$$

$$Z \approx 2$$

Hence, it is body centered cubic structure. For bcc , if a is the edge length of the cube and y is the radius of atom then,

$$4r = \sqrt{3}a$$

$$r = \frac{\sqrt{3}}{4}a = \frac{\sqrt{3}}{4} \times 5 \text{ \AA} = 2.165 \text{ \AA} = 216 \text{ pm}$$



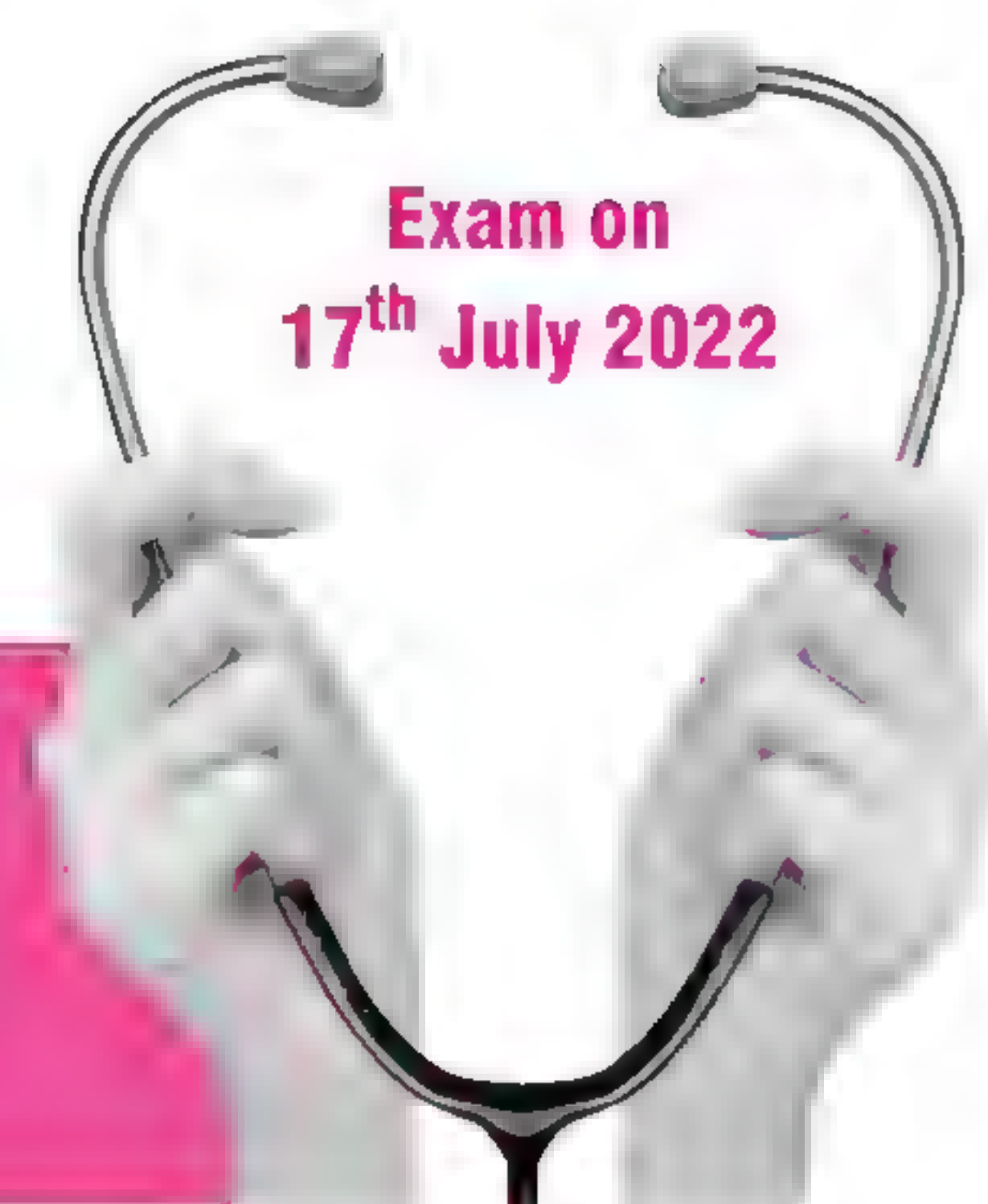
$X = \text{B}_2\text{H}_6$; $Y = \text{B}_3\text{N}_3\text{H}_6$ (Inorganic benzene)

Total no. of boron atoms = $2 + 3 = 5$

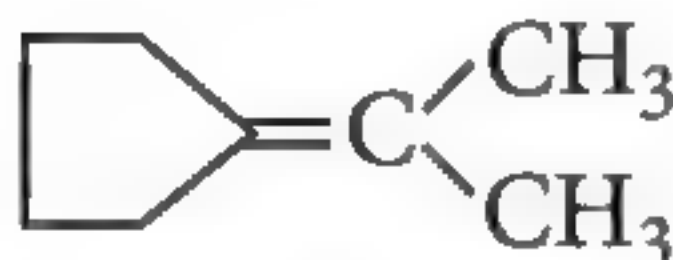
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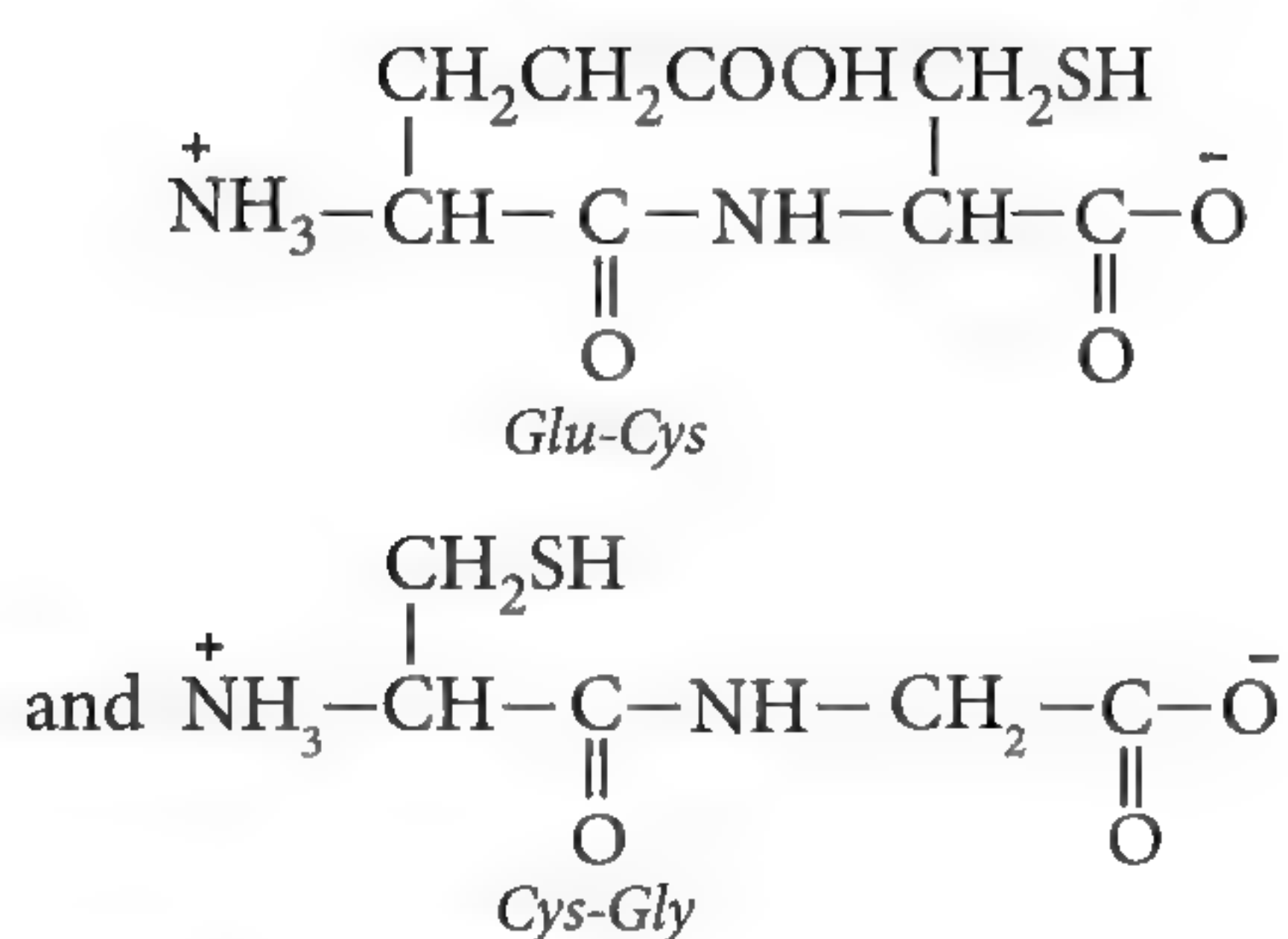
NEET 2022

Exam on
17th July 2022



SECTION - A

- Which of the following alkenes on ozonolysis gives a mixture of ketones only?
(a) $\text{CH}_3 - \text{CH} = \text{CH} - \text{CH}_3$
(b) $\text{CH}_3 - \underset{\text{CH}_3}{\text{CH}} - \text{CH} = \text{CH}_2$
(c)  (d) $\text{H}_2\text{C} = \text{CH}_2$
- The kinetic energy of 4 moles of nitrogen gas at 127°C is ($R = 2 \text{ cal mol}^{-1} \text{ K}^{-1}$)
(a) 4400 cal (b) 3200 cal
(c) 4800 cal (d) 1524 cal
- Naturally occurring sugars and amino acids have configuration respectively,
(a) *L*-sugars, *D*-amino acids
(b) *D*-sugars, *D*-amino acids
(c) *D*-sugars, *L*-amino acids
(d) *L*-sugars, *L*-amino acids.
- The hydrides of the first elements in groups 15-17, namely NH_3 , H_2O and HF respectively show abnormally high values for melting and boiling points. This is due to
(a) small size of N, O and F
(b) the ability to form extensive intermolecular H-bonding
(c) the ability to form extensive intramolecular H-bonding
(d) effective van der Waals' interaction.
- Phenol on oxidation gives quinone. The oxidant used is
(a) $\text{K}_2\text{S}_2\text{O}_8$ (b) KMnO_4
(c) $\text{Na}_2\text{Cr}_2\text{O}_7$, H_2SO_4 (d) none of these.
- Calculate the weight of metal deposited when a current of 15 ampere with 75% current efficiency is passed through the cell for 2 hours.
(Electrochemical equivalent of metal = 4×10^{-4})
(a) 32.4 g (b) 43.2 g
(c) 57.6 g (d) 16.2 g
- The correct order of ionisation energy of C, N, O and F is
(a) $\text{F} < \text{N} < \text{C} < \text{O}$ (b) $\text{C} < \text{N} < \text{O} < \text{F}$
(c) $\text{C} < \text{O} < \text{N} < \text{F}$ (d) $\text{F} < \text{O} < \text{N} < \text{C}$
- Schottky defect in crystals is observed when
(a) unequal number of cations and anions are missing from the lattice
(b) equal number of cations and anions are missing from the lattice
(c) anion leaves its normal site and occupies an interstitial site
(d) density of the crystal is increased.
- By mistake, an alcohol (boiling point 97°C) was mixed with a hydrocarbon (boiling point 68°C). Method used to separate the two compounds is
(a) steam distillation
(b) distillation
(c) fractional distillation
(d) differential extraction.
- Thermal decomposition method is used to purify
(a) Ni (b) Cr
(c) Sn (d) Pb
- Which of the following on thermal decomposition yields a basic as well as an acidic oxide?
(a) KClO_3 (b) CaCO_3
(c) NH_4NO_3 (d) NaNO_3
- A tripeptide (X) on partial hydrolysis gave two dipeptides *Cys-Gly* and *Glu-Cys*, i.e.,



Identify the tripeptide.

- (a) Glu-Cys-Gly (b) Gly-Glu-Cys
(c) Cys-Gly-Glu (d) Cys-Glu-Gly

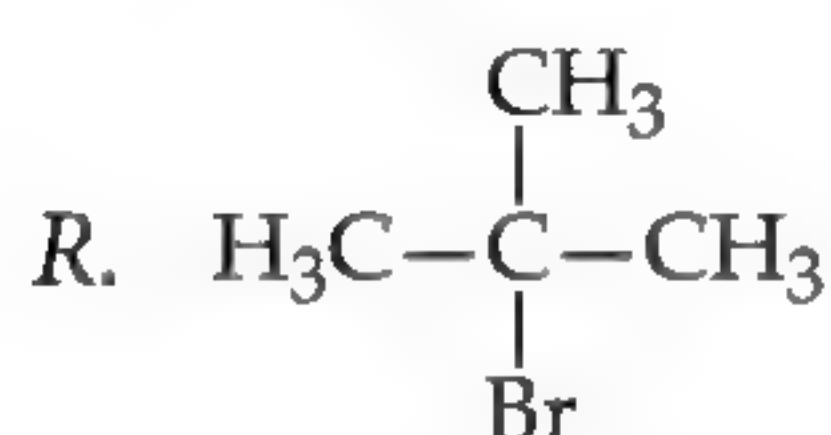
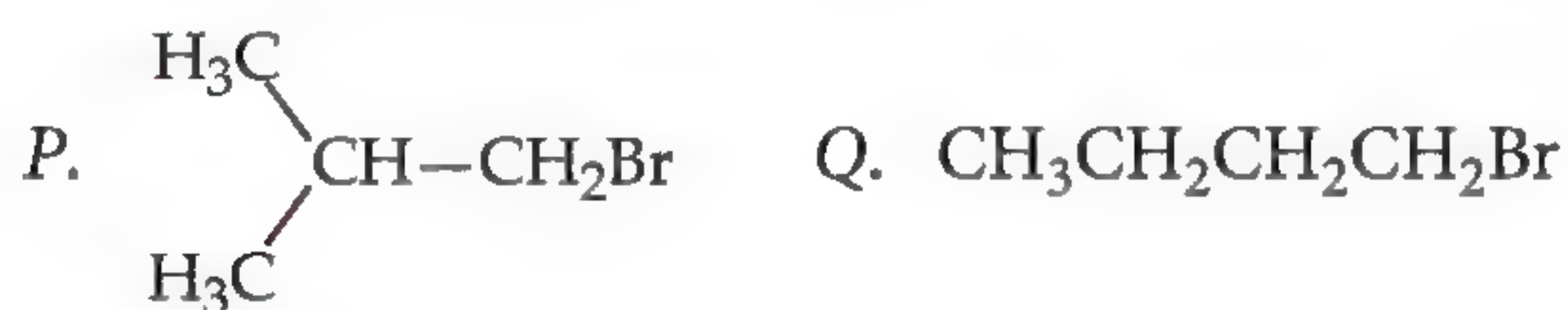
13. Avogadro number (6.023×10^{23}) of carbon atoms are present in

- (a) 12 grams of $^{12}\text{CO}_2$
(b) 22.4 litre of $^{12}\text{CO}_2$ in room temperature
(c) 44 grams of $^{12}\text{CO}_2$
(d) 12 moles of $^{12}\text{CO}_2$

14. The slag obtained during the extraction of copper from copper pyrites is composed mainly of

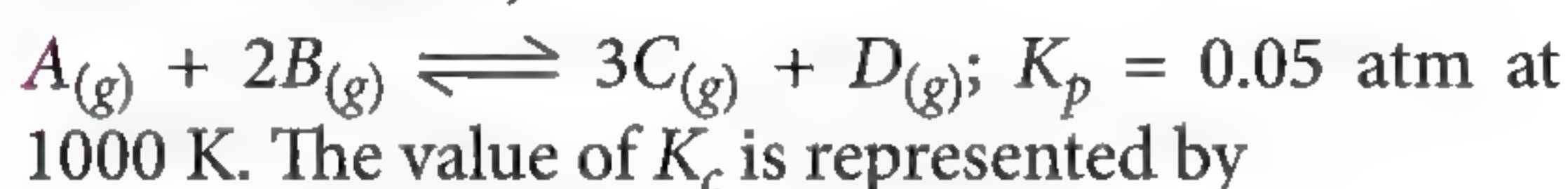
- (a) Au_2S (b) FeSiO_3 (c) CuSiO_3 (d) SiO_2

15. Arrange the following compounds in increasing order of their boiling points.



- (a) $Q < P < R$ (b) $P < Q < R$
(c) $R < P < Q$ (d) $R < Q < P$

16. For the reaction,

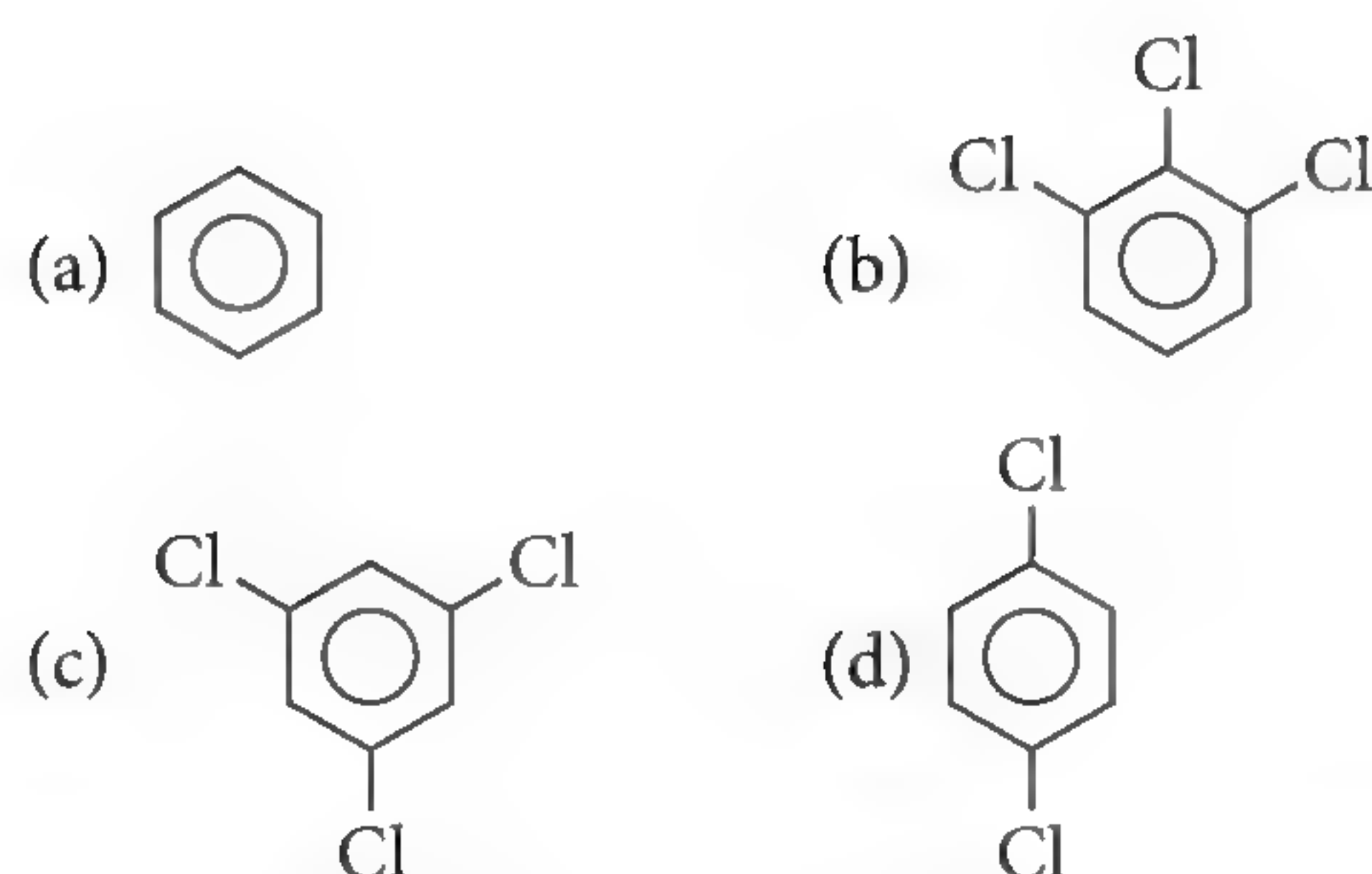


- (a) $5 \times 10^{-4} R$ (b) $\frac{5 \times 10^{-4}}{R}$
(c) $5 \times 10^{-5} R$ (d) $\frac{5 \times 10^{-5}}{R}$

17. Which of the following does not liberate O_2 on heating?

- (a) MgO (b) NaNO_3
(c) Pb_3O_4 (d) KClO_3

18. Which of the following will have maximum dipole moment?



19. In which of the following pairs, the hybridisation of central atoms is same, but geometry is not the same?

- (a) SO_3 , CO_3^{2-} (b) SO_3^{2-} , NH_3
(c) PCl_5 , POCl_3 (d) XeF_2 , ICl_3

20. Assuming 100% dissociation, the increasing order of the freezing point of the solution will be

- (a) $0.10 \text{ mol kg}^{-1} \text{Ba}_3(\text{PO}_4)_2 < 0.10 \text{ mol kg}^{-1} \text{Na}_2\text{SO}_4 < 0.10 \text{ mol kg}^{-1} \text{KCl}$
(b) $0.10 \text{ mol kg}^{-1} \text{KCl} < 0.10 \text{ mol kg}^{-1} \text{Na}_2\text{SO}_4 < 0.10 \text{ mol kg}^{-1} \text{Ba}_3(\text{PO}_4)_2$
(c) $0.10 \text{ mol kg}^{-1} \text{Na}_2\text{SO}_4 < 0.10 \text{ mol kg}^{-1} \text{Ba}_3(\text{PO}_4)_2 < 0.10 \text{ mol kg}^{-1} \text{KCl}$
(d) $0.10 \text{ mol kg}^{-1} \text{KCl} < 0.10 \text{ mol kg}^{-1} \text{Ba}_3(\text{PO}_4)_2 < 0.10 \text{ mol kg}^{-1} \text{Na}_2\text{SO}_4$

21. Phenol on treatment with excess conc. HNO_3 gives

- (a) *o*-nitrophenol (b) *p*-nitrophenol
(c) *o*- and *p*-nitrophenol (d) 2,4,6-trinitrophenol.

22. A van der Waals' gas may behave ideally when

- (a) the volume is very low
(b) the temperature is very low
(c) the pressure is very low
(d) the temperature, pressure and volume all are very high.

23. Which of the following is a cyclic phosphate?

- (a) $\text{H}_3\text{P}_3\text{O}_{10}$ (b) $\text{H}_6\text{P}_4\text{O}_{13}$
(c) $\text{H}_5\text{P}_5\text{O}_{15}$ (d) $\text{H}_7\text{P}_5\text{O}_{16}$

24. The product of reaction between aniline and acetic anhydride is

- (a) *o*-aminoacetophenone
(b) *m*-aminoacetophenone
(c) *p*-aminoacetophenone
(d) acetanilide.

25. A gas is allowed to expand at constant temperature from a volume of 1.0 L to 10.0 L against an external pressure of 0.50 atm. If the gas absorbs 250 J of heat from the surroundings, what are the values of q , W and ΔE ?

(Given 1 L atm = 101 J)

	q	W	ΔE
(a)	250 J	-455 J	-205 J
(b)	-250 J	-455 J	-710 J
(c)	250 J	455 J	710 J
(d)	-250 J	455 J	205 J

26. The melting point of copper is higher than that of zinc because
 (a) copper has a *bcc* structure
 (b) the atomic volume of copper is higher
 (c) the *d*-electrons of copper are involved in metallic bonding
 (d) the *s*-as well as *d*-electrons of copper are involved in metallic bonding.

27. In aqueous alkaline solution, two electron reduction of HO_2^- gives
 (a) OH^- (b) H_2O (c) O_2 (d) O_2^-

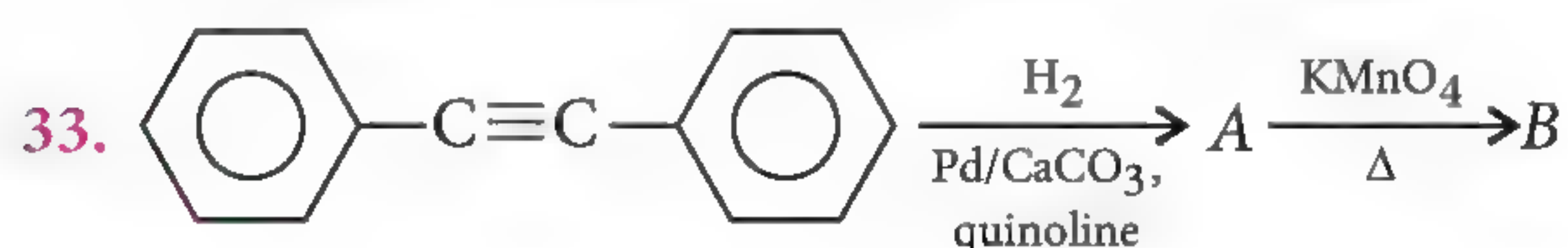
28. The coordination number of a metal crystallizing in a hexagonal close-packed structure is
 (a) 12 (b) 4
 (c) 8 (d) 6

29. When H_2O_2 is shaken with an acidified solution of $\text{K}_2\text{Cr}_2\text{O}_7$ in presence of ether, the ethereal layer turns blue due to the formation of
 (a) Cr_2O_3 (b) CrO_4^{2-}
 (c) $\text{Cr}_2(\text{SO}_4)_3$ (d) CrO_5

30. A hypothetical reaction, $\text{A}_2 + \text{B}_2 \longrightarrow 2\text{AB}$ follows the mechanism as given below;
 $\text{A}_2 \rightleftharpoons \text{A} + \text{A} \dots\dots(\text{fast})$
 $\text{A} + \text{B}_2 \longrightarrow \text{AB} + \text{B} \dots\dots(\text{slow})$
 $\text{A} + \text{B} \longrightarrow \text{AB} \dots\dots(\text{fast})$
 The order of the overall reaction is
 (a) 2 (b) 1
 (c) $1\frac{1}{2}$ (d) zero.

31. The complex showing a spin-only magnetic moment of 2.82 B.M. is
 (a) $\text{Ni}(\text{CO})_4$ (b) $[\text{NiCl}_4]^{2-}$
 (c) $\text{Ni}(\text{PPh}_3)_4$ (d) $[\text{Ni}(\text{CN})_4]^{2-}$

32. The root mean square velocity of hydrogen at STP is $1.83 \times 10^5 \text{ cm sec}^{-1}$ and its mean free path is $1.78 \times 10^{-5} \text{ cm}$. What will be the collision number at STP?
 (a) $9.476 \times 10^9 \text{ sec}^{-1}$ (b) $9.746 \times 10^{-9} \text{ sec}^{-1}$
 (c) $9.746 \times 10^9 \text{ sec}^{-1}$ (d) $9.647 \times 10^9 \text{ sec}^{-1}$

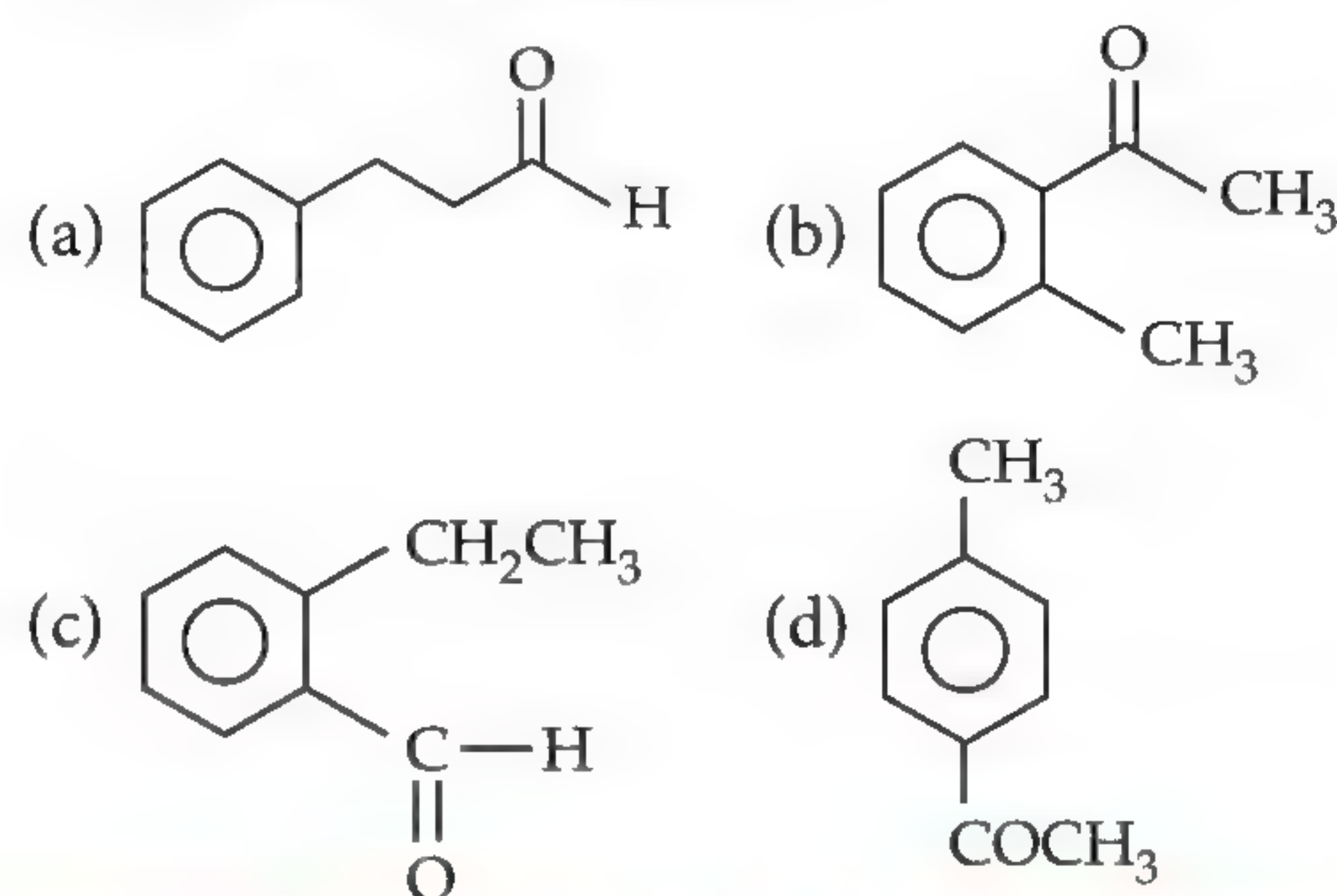


Identify A and B.

- (a) $\text{C}_6\text{H}_5\text{CH}=\text{CHC}_6\text{H}_5$, $\text{C}_6\text{H}_5\text{CH}_2\text{COOH}$
 (b) $\text{C}_6\text{H}_5\text{CH}=\text{CHC}_6\text{H}_5$, $\text{C}_6\text{H}_5\text{COOH}$
 (c) $\text{C}_6\text{H}_5\text{CH}_2\text{CH}_3$, $\text{C}_6\text{H}_5\text{CHO}$
 (d) $\text{C}_6\text{H}_5\text{CH}=\text{CHC}_6\text{H}_5$, $\text{C}_6\text{H}_5\text{CHO}$

34. The CMC of a given soap in water is $10^{-3} \text{ mol litre}^{-1}$. A $10^{-4} \text{ mol litre}^{-1}$ solution of this soap in water is a
 (a) lyophilic sol (b) lyophobic sol
 (c) true solution (d) none of these.

35. An organic compound with the molecular formula $\text{C}_9\text{H}_{10}\text{O}$ forms 2, 4-DNP derivative, reduces Tollens' reagent and undergoes Cannizzaro reaction. On vigorous oxidation, it gives benzene-1, 2-dicarboxylic acid. Identify the compound.

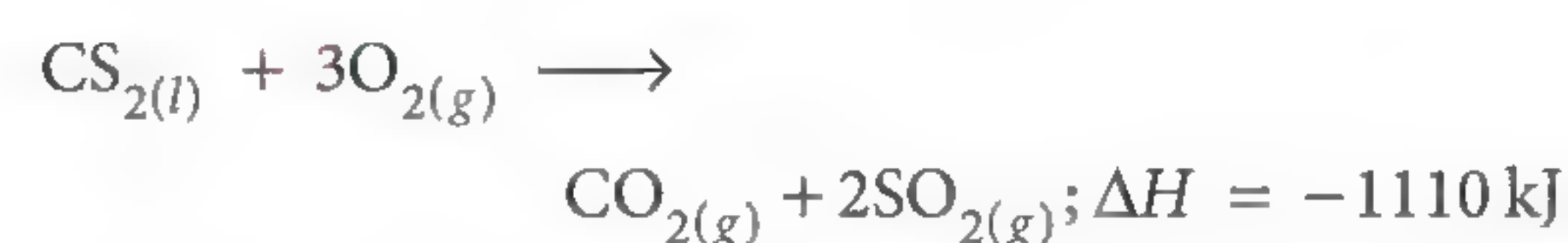


SECTION - B

Attempt any 10 out of 15.

36. Which of the following is not a step growth polymer?
 (a) Polybutadiene (b) Nylon-6, 6
 (c) Glyptal (d) Terylene.

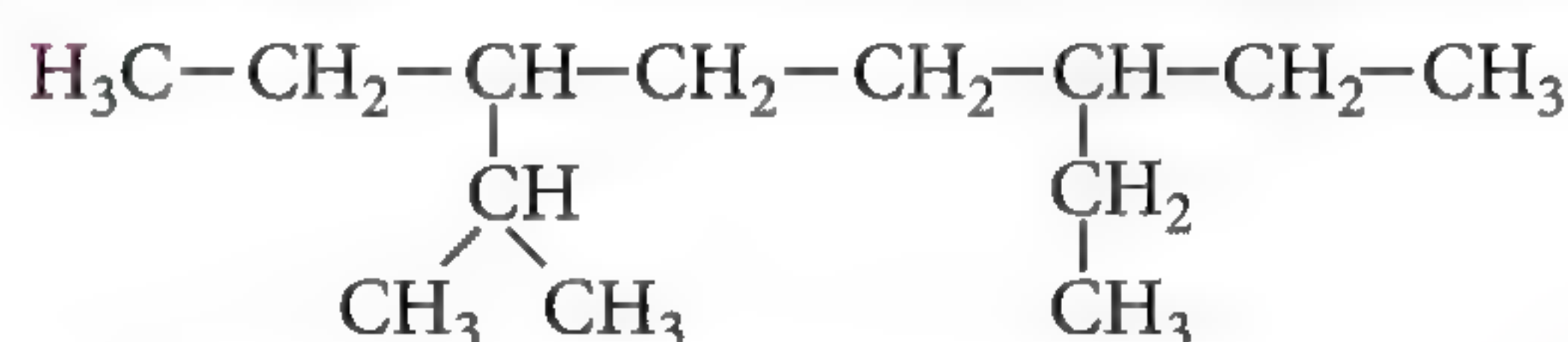
37. Given :



The heat of formation of $\text{CS}_{2(l)}$ is

- (a) 125 kJ mol^{-1} (b) $31.25 \text{ kJ mol}^{-1}$
 (c) 62.5 kJ mol^{-1} (d) 250 kJ mol^{-1}

38. The correct IUPAC name of the following alkane is



- (a) 3,6-diethyl-2-methyloctane
 (b) 5-iso-propyl-3-ethyloctane

- (c) 3-ethyl-5-*iso*-propyloctane
(d) 3-*iso*-propyl-6-ethyloctane.
39. Which of the following statements is false regarding alkali metals?
(a) Alkali metals are soft and can be cut with the help of knife.
(b) Alkali metals do not occur in free state in nature.
(c) Alkali metals are highly electropositive elements.
(d) Alkali metal hydrides are covalent in character.
40. A dry air is passed through the solution, containing the 10 g of solute and 90 g of water and then it is passed through pure water. There is the depression in weight of solution by 2.5 g and in weight of pure solvent by 0.05 g. Calculate the molecular weight (in g mol^{-1}) of solute.
(a) 25 (b) 50 (c) 100 (d) 180
41. Analysis of chlorophyll shows that it contains 2.68 percent magnesium. How many atoms of magnesium does 100 g of chlorophyll contain?
(a) 6.72×10^{22} atoms (b) 7.61×10^{22} atoms
(c) 6.72×10^{23} atoms (d) 6.022×10^{22} atoms
42. How many metameric ethers are represented by the molecular formula $\text{C}_4\text{H}_{10}\text{O}$?
(a) 4 (b) 3 (c) 2 (d) 5
43. Back bonding in BF_3 does not affect
(a) planarity, Lewis acidic strength and bond angle
(b) bond length, hybridisation and bond strength
(c) bond angle, planarity, geometry
(d) Lewis acidity, bond length, bond order (B – F).
44. A compound with nitro group was reduced by Sn/HCl , followed by treatment with NaNO_2/HCl and followed by phenol. The chromophore group in the final compound is
(a) NO_2 group (b) NH_2 group
(c) azo group (d) OH group.
45. The pH of a solution prepared by mixing 2M, 100 mL HCl and 1 M, 200 mL NaOH at 25°C is
(a) 8 (b) 7 (c) 4 (d) 5
46. The number of aldol reaction(s) that occurs in the given transformation is

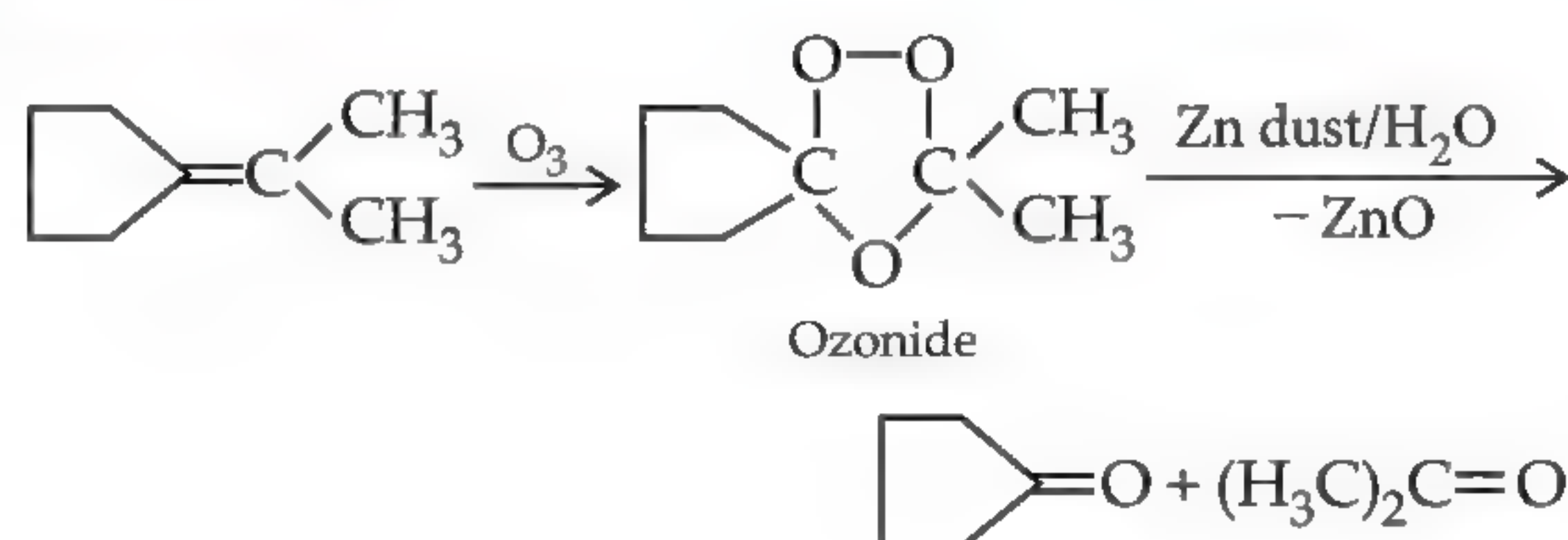
$$\text{CH}_3\text{CHO} + 4\text{HCHO} \xrightarrow{\text{NaOH}} \begin{array}{c} \text{HO} \quad \text{OH} \\ | \quad | \\ \text{HO} - \text{C} - \text{C} - \text{OH} \\ | \quad | \\ \text{HO} \quad \text{OH} \end{array} + \text{HCOO}^-\text{Na}^+$$

(a) 1 (b) 2 (c) 3 (d) 4
47. The bond present in borazole ($\text{B}_3\text{N}_3\text{H}_6$) are
(a) 9 σ , 6 π (b) 12 σ , 3 π
(c) 6 σ , 9 π (d) 15 σ only

48. The quantity of electricity required to liberate 112 cm^3 of hydrogen at STP from acidified water is
(a) 0.1 faraday (b) 96500 coulomb
(c) 965 coulomb (d) 10 faraday.
49. Which one of the following statements is not true?
(a) pH of drinking water should be between 5.5 – 9.5.
(b) Concentration of DO below 6 ppm is good for the growth of fish.
(c) Clean water would have a BOD value of less than 5 ppm.
(d) Oxides of sulphur, nitrogen and carbon are the most widespread air pollutants.
50. Consider the following statements.
(I) Antibiotics which kill the microorganisms are known as bactericidal drugs.
(II) Antibiotics which inhibit the growth of microorganisms are known as bacteriostatic drugs.
(III) Penicillin-G is a broad spectrum antibiotic.
Correct statements are
(a) (II) and (III) (b) (I), (II) and (III)
(c) (I) and (II) (d) (I) and (III)

SOLUTIONS

1. (c) : Only compound given in option (c) will give ketones on ozonolysis, others will give mixture of aldehydes.



2. (c) : $K.E = \frac{3}{2} nRT$

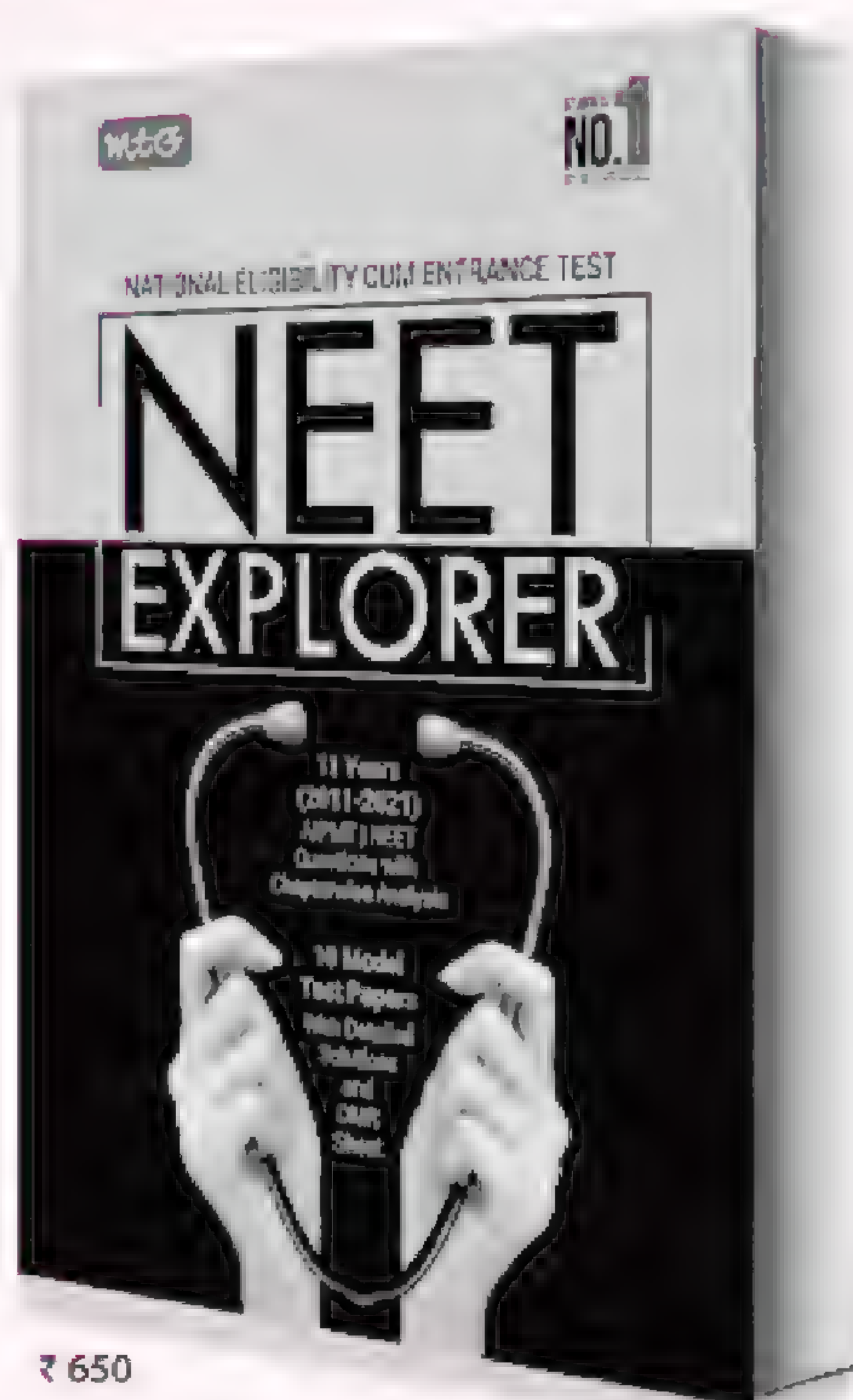
$$= \frac{3}{2} \times (4 \text{ mol}) \times (2 \text{ cal mol}^{-1} \text{ K}^{-1}) \times (400 \text{ K}) = 4800 \text{ cal}$$
3. (c) : D - Sugars, L-amino acids.
4. (b) :

Atom	Electronegativity in Pauling scale
F	4.0
O	3.5
N	3.0

Thus, NH_3 , H_2O and HF can form extensive inter-molecular H-bonding.

mtg

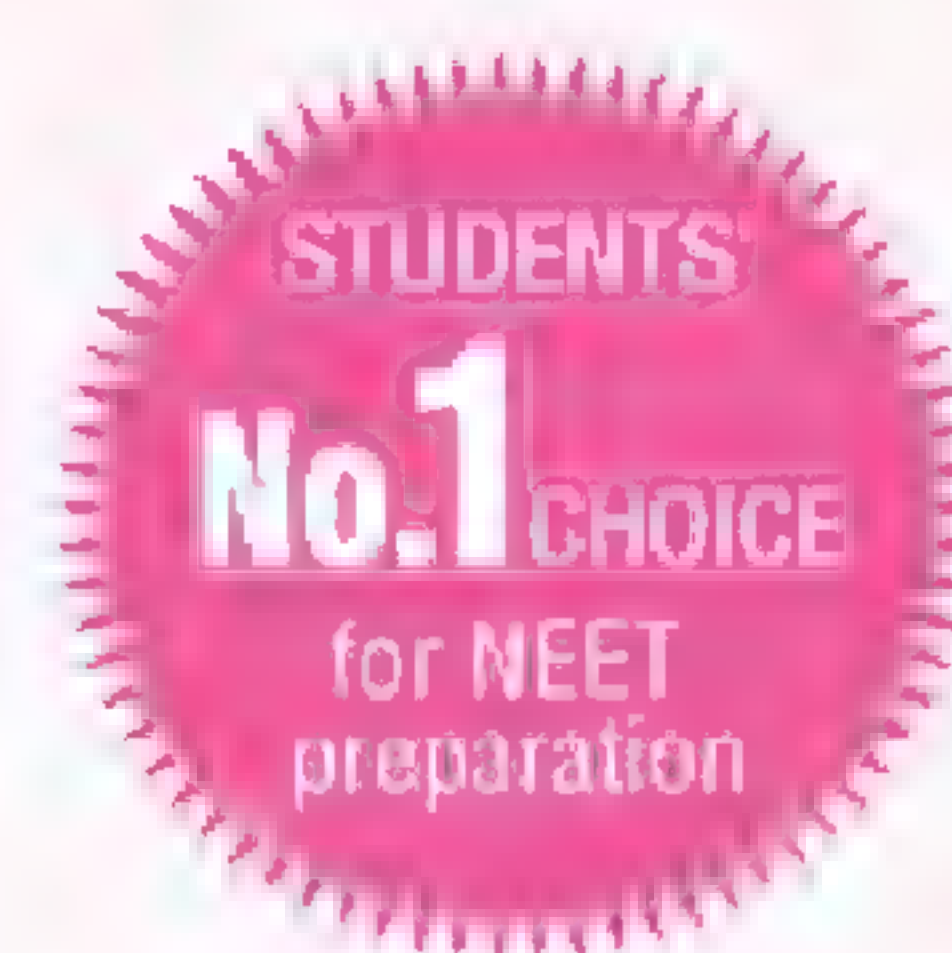
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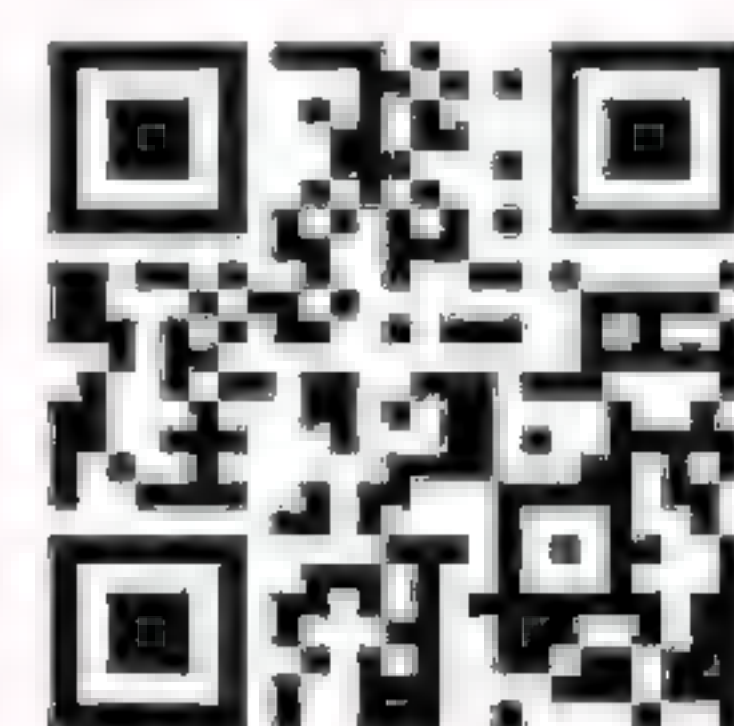
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HIGHLIGHTS:

- 10 Model Test Papers based on latest NEET syllabus
- Last 11 years' solved test papers of AIPMT / NEET
- Includes NEET 2021 solved paper
- OMR Sheet provided after each Model Test Paper
- Detailed solutions for self-assessment and to practice time management



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6. (a): Weight = $Z \times Q = Z \times I \times t$

$$= 4 \times 10^{-4} \times 15 \times \frac{75}{100} \times 2 \times 60 \times 60 \Rightarrow 32.4 \text{ g}$$

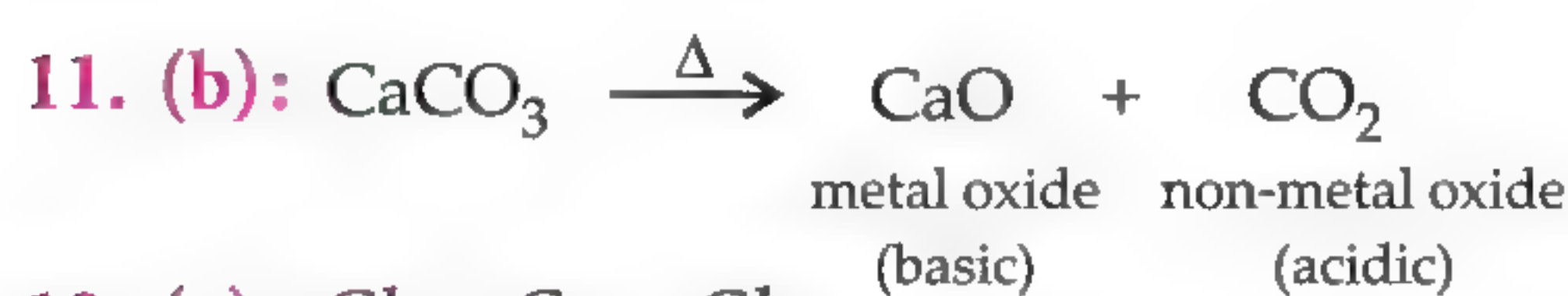
7. (c): In a period, the value of ionisation enthalpy increases from left to right with irregularity where the atoms have somewhat stable configurations. In nitrogen (second period) $2p$ -orbitals are half filled leading to higher value of ionisation energy than oxygen.

Hence, the order is $C < O < N < F$.

8. (b): In Schottky defect, equal number of cations and anions are missing from the lattice.

9. (b): Simple distillation can be used because these two compounds have a difference of more than 20°C in their boiling points and can be distilled out without any decomposition.

10. (a) : Ni combines with CO at 323 K to form $\text{Ni}(\text{CO})_4$ which decomposes thermally at 423 K to give pure Ni metal.



12. (a): *Glu - Cys - Gly*

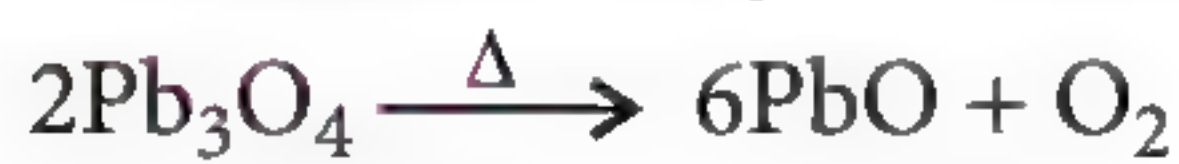
13. (c) : 1 mole of CO_2 = Gram molecular mass of CO_2 (44 g) = 6.023×10^{23} molecules of CO_2
= 6.023×10^{23} atoms of carbon



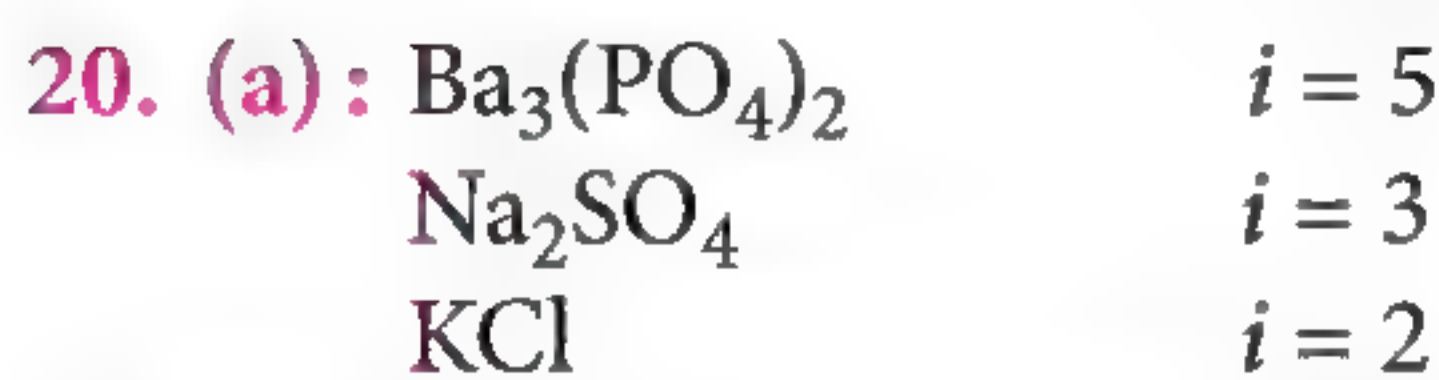
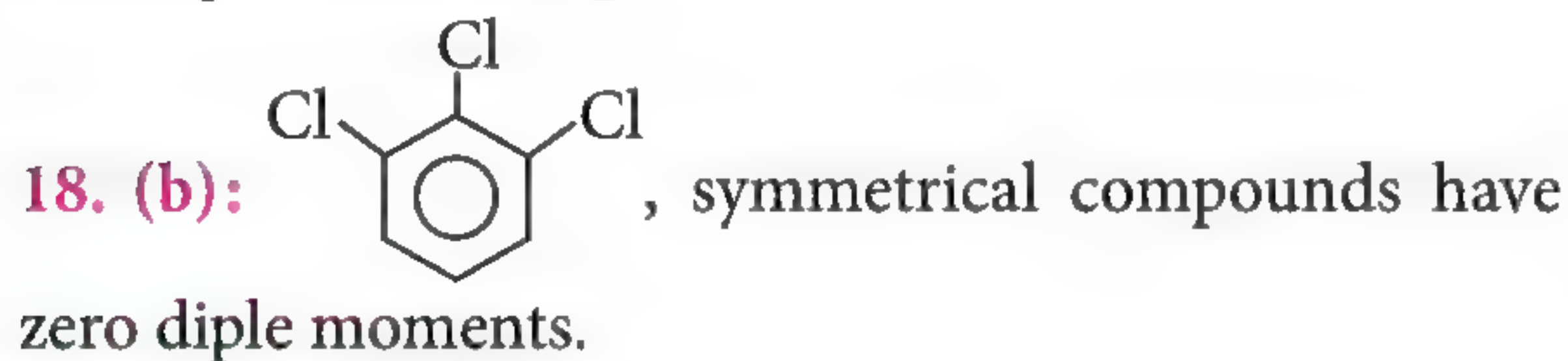
15. (c) : $R < P < Q$, boiling points decrease on increasing branching.

16. (d): $K_p = K_c(RT)^{\Delta n}$, $\Delta n = 4 - 3 = 1$

$$K_c = \frac{K_p}{RT} = \frac{0.05}{R \times 1000} = \frac{5 \times 10^{-5}}{R}$$

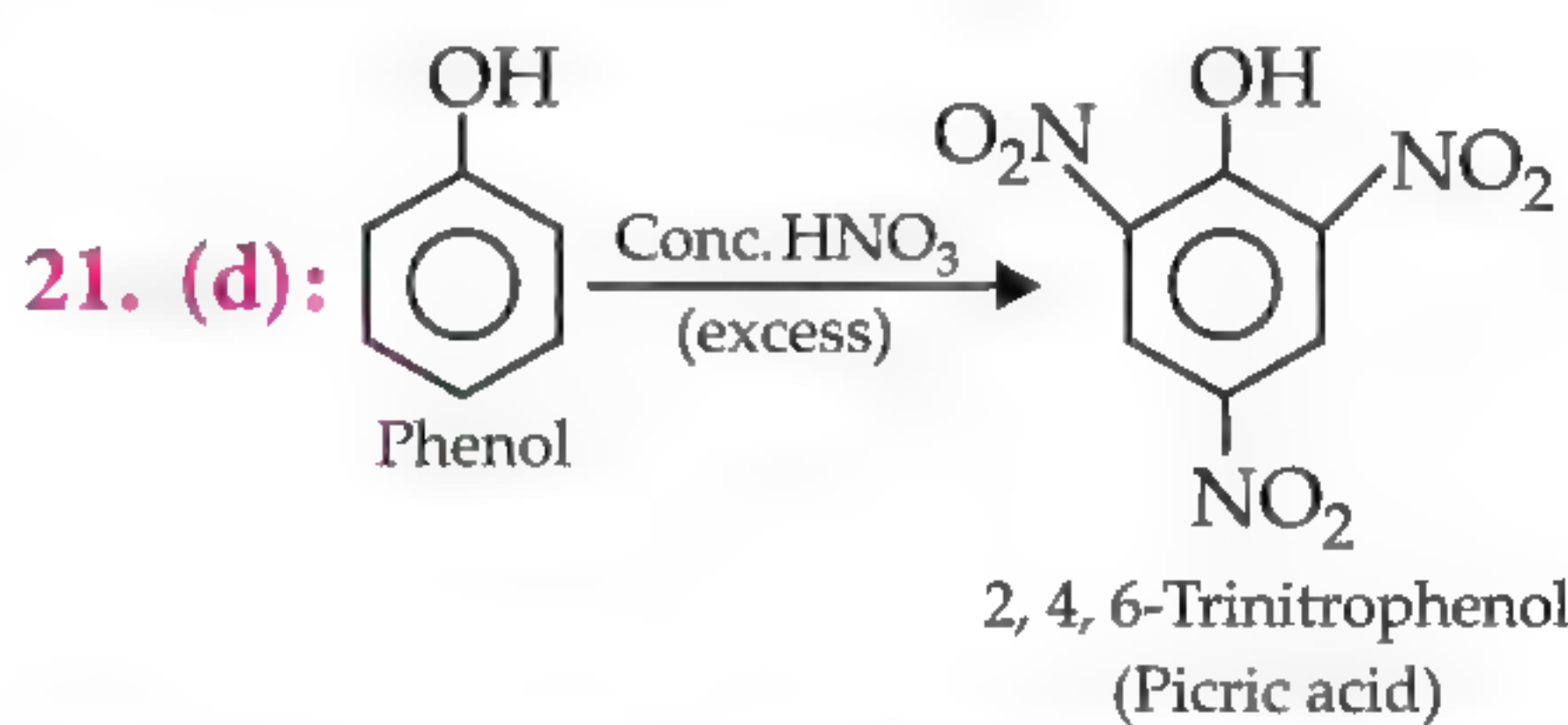
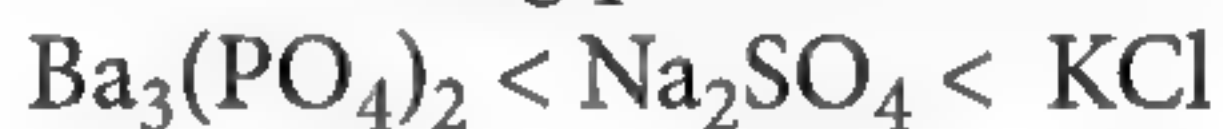


MgO being high melting oxide does not decompose on heating to liberate O_2 .



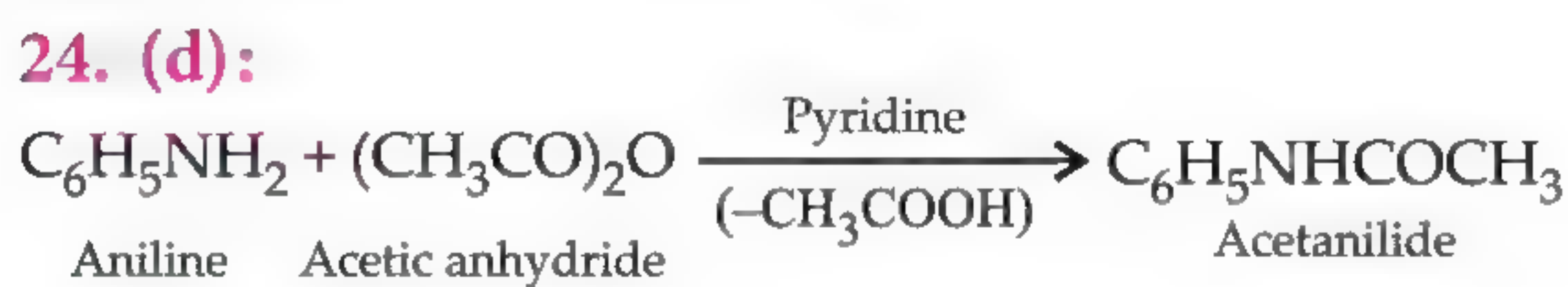
For the same concentration, depression in freezing point; $\Delta T_f \propto i$

\therefore Freezing point will have the order :



22. (c) : van der Waals' gas may behave ideally when pressure is very low as compressibility factor (Z) approaches to 1. At high temperature $Z > 1$.

23. (c) : Metaphosphates have cyclic structure with general formula $(\text{HPO}_3)_n$.



25. (a): Applying, $W = -P\Delta V$

$$\Delta V = V_2 - V_1 = 10 - 1 = 9 \text{ L}, P = 0.5 \text{ atm}$$

$$W = -0.5 \times 9 = -4.5 \text{ L atm} = -4.5 \times 101.3 \approx -455 \text{ J}$$

Since the heat is absorbed by gas

Hence $q = +250 \text{ J}$

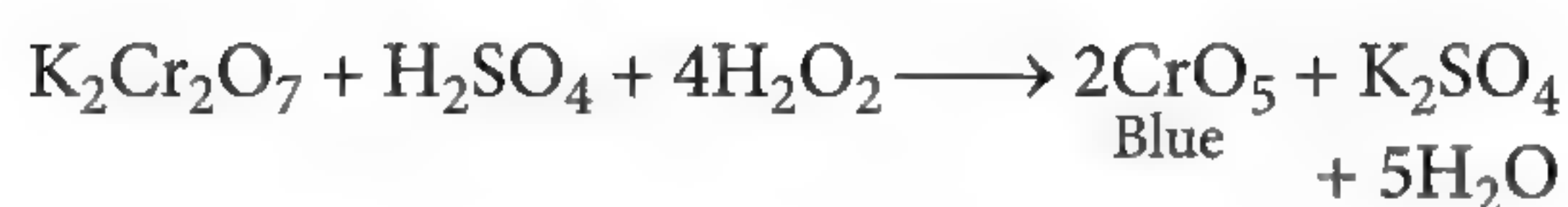
$$\Delta E = q + W = 250 - 455 = -205 \text{ J}$$

26. (c) : In case of copper, d -electrons are involved in metallic bonding that's why melting points of Cu is higher than that of Zn.



28. (a): In case of *hcp*, the atoms are located at the corners and centre of two hexagons placed parallel to each other, three more atoms are placed midway between these two planes. In such an arrangement each atom is surrounded by 12 others and so it has a coordination number 12.

29. (d): Acidified $\text{K}_2\text{Cr}_2\text{O}_7$ solution reacts with hydrogen peroxide to give a deep blue solution due to the formation of peroxo compound CrO_5 .



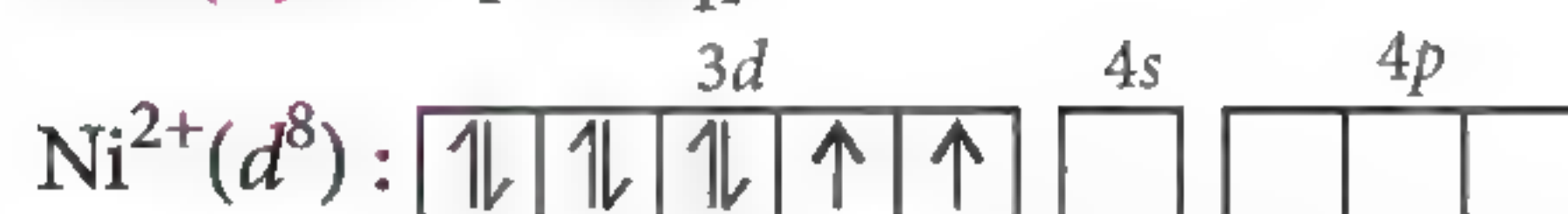
30. (c) : For slow step, $r = k[A][B_2]$

$$\text{and } K_c = \frac{[A][A]}{[A_2]} \text{ or } [A] = K_c^{1/2}[A_2]^{1/2}$$

$$\begin{aligned} \text{Thus, } r &= k \cdot K_c^{1/2}[A_2]^{1/2}[B_2] \\ &= k_1[A_2]^{1/2}[B_2] \end{aligned} \quad \{k_1 = k \cdot K_c^{1/2}\}$$

Hence, order is $\frac{3}{2}$.

31. (b): In $[\text{NiCl}_4]^{2-}$



Chloride is a weak field ligand, it does not cause pairing of electrons in the 3d orbital and hence Ni^{2+} undergoes sp^3 hybridisation.

$$\therefore n = \text{no. of unpaired electron} = 2$$

$$\Rightarrow \mu = \sqrt{n(n+2)} = \sqrt{2(2+2)} = 2.82 \text{ B.M.}$$

32. (a): $u_{r.m.s} = 1.83 \times 10^5 \text{ cm sec}^{-1}$

$$\text{Average velocity, } \bar{u} = 0.9213 \times u_{r.m.s.}$$



PUBLIC NOTICE

NEET (UG) 2022

Sub : National Eligibility-cum-Entrance Test [(NEET (UG)) - 2022

The National Testing Agency (NTA) is inviting Online Applications for NEET (UG) – 2022 for admission to the undergraduate medical courses in all medical institutions in India. As per Section 14 of The National Medical Commission Act, 2019, the NEET (UG) has to be conducted as a common and uniform National Eligibility-cum-Entrance Test [(NEET (UG))] for admission to undergraduate medical education in all medical institutions, including those governed under any other law in force.

The Entrance Test shall consist of 200 multiple choice questions (four options with a single correct answer) from Physics, Chemistry, and Biology (Botany & Zoology). 50 questions in each subject will be divided into two Sections (A and B). The duration of the Examination will be 200 minutes (03 hours 20 minutes) from 02:00 PM to 05:20 PM (IST).

[A total of approximately 543 cities in India and 14 Cities Outside India (Annexure-I) have been added for NEET (UG) – 2022.]

NEET (UG) – 2022 will be conducted in 13 languages i.e. English, Hindi, Assamese, Bengali, Gujarati, Kannada, Malayalam, Marathi, Odia, Punjabi, Tamil, Telugu, and Urdu.

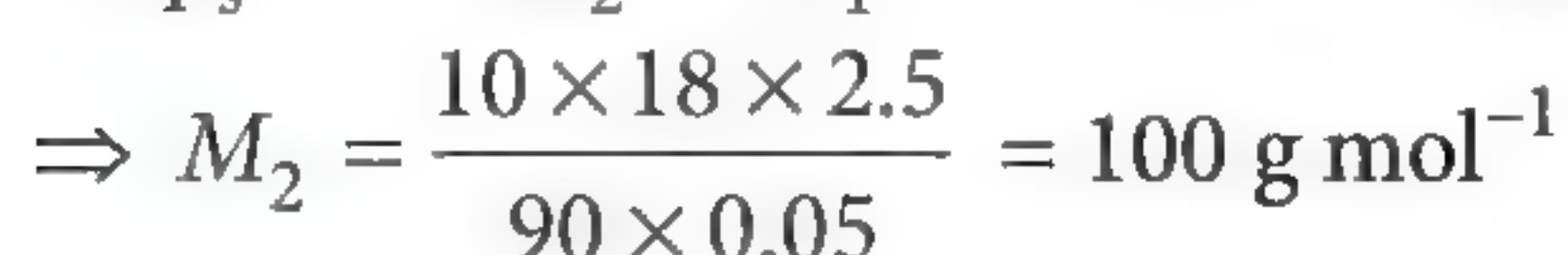
Online Submission of Application Form		06 April to 06 May 2022 (up to 11:50 PM)	
Last date of successful transaction of fee through Credit/Debit Card/ Net-Banking/UPI / Paytm		07 May 2022 (up to 11:50 PM)	
Correction in Particulars		To be intimated later on the website	
Fee Payable by Candidate	Category of Candidate	In India (Fee in ₹)	Outside India (Fee in ₹)
	General	₹ 1600/-	₹ 8500/-
	General-EWS/ OBC-NCL*	₹ 1500/-	
	SC/ST/PwBD/Third Gender	₹ 900/-	
Processing charges & Goods and Services Tax (GST) are to be paid by the candidate, as applicable			
Announcement of the City of Examination		To be intimated later on the website	
Downloading of Admit Cards from the NTA website		To be intimated later on the website	
Date of Examination		17 July 2022 (Sunday)	
Duration of Examination		200 minutes (03 hours 20 Minutes)	
Timing of Examination		02:00 PM to 05:20 PM (IST)	
Centre, Date, and Shift of NEET (UG) - 2022 Examination		As indicated on Admit Card	
Display of Recorded Responses and Answer Keys		To be announced later on the website	
Website(s)		www.nta.ac.in, https://neet.nta.nic.in/	
Declaration of Result on the NTA website		To be announced later on the website	

OBC-NCL (Other Backward Classes)-NCL (Non-Creamy Layer) as per the Central List of Other Backward Classes available on the National Commission for Backward Classes. The candidates falling on this list (available on <http://www.ncbc.nic.in/>) may mention OBC-NCL in the Category Column. State-listed OBC-NCL Candidates who are not in OBC-NCL (Central List) must choose General.

Candidates, who desire to appear in NEET (UG) – 2022, may see the detailed Information Bulletin available on the website: <https://neet.nta.nic.in/>

$$\text{Mean free path } (\lambda) = \frac{\text{Average velocity}}{\text{Collision number}}$$

33. (b): $\text{C}_6\text{H}_5\text{C}\equiv\text{CC}_6\text{H}_5 \xrightarrow[\text{Pd/CaCO}_3, \text{quinoline}]{\text{H}_2}$



48. (c) 49. (b) 50. (c)

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PRACTICE PAPER

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Exam on
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PAPER - I

SECTION 1

- This section contains FOUR (04) questions.
- Each question has FOUR options (a), (b), (c) and (d). ONLY ONE of these four options is the correct answer.
- For each question, choose the correct option corresponding to the correct answer.
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +3 If ONLY the correct option is chosen.

Zero Marks : 0 If none of the options is chosen (i.e., the question is unanswered).

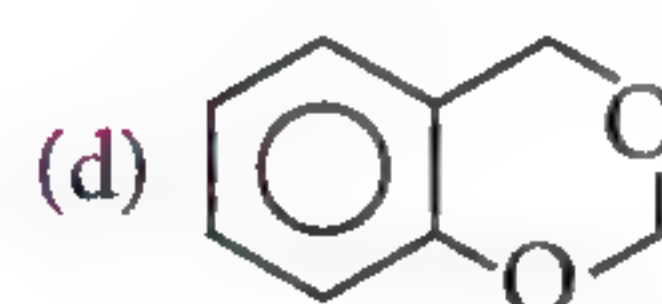
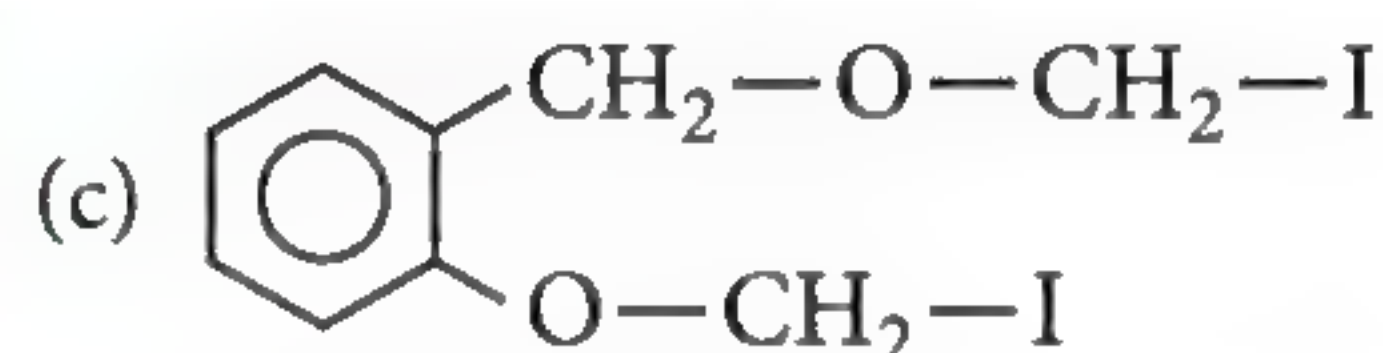
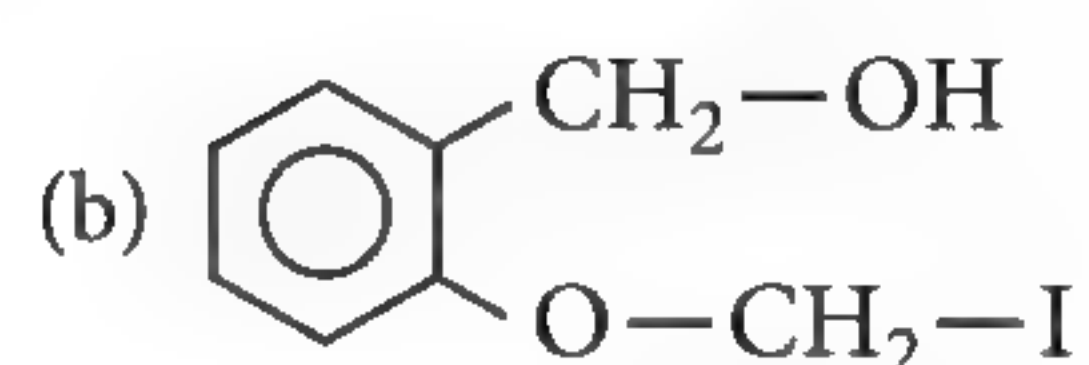
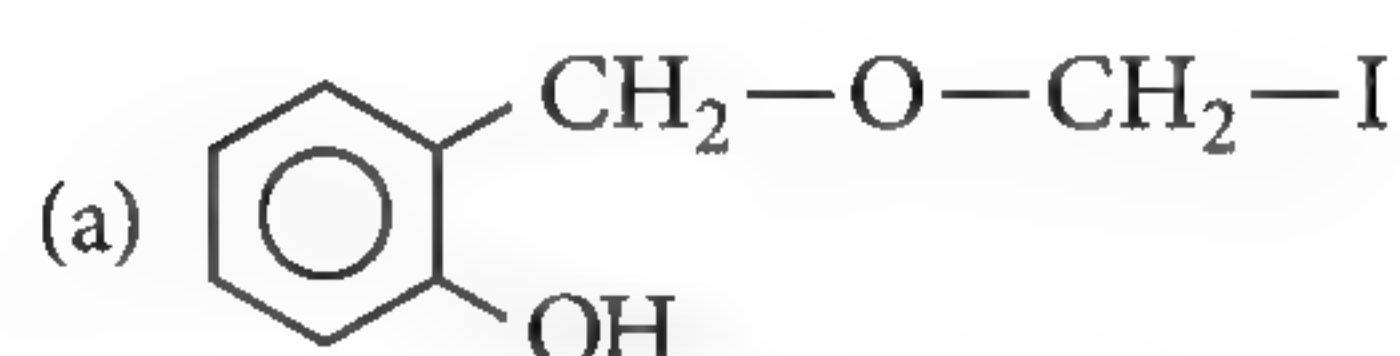
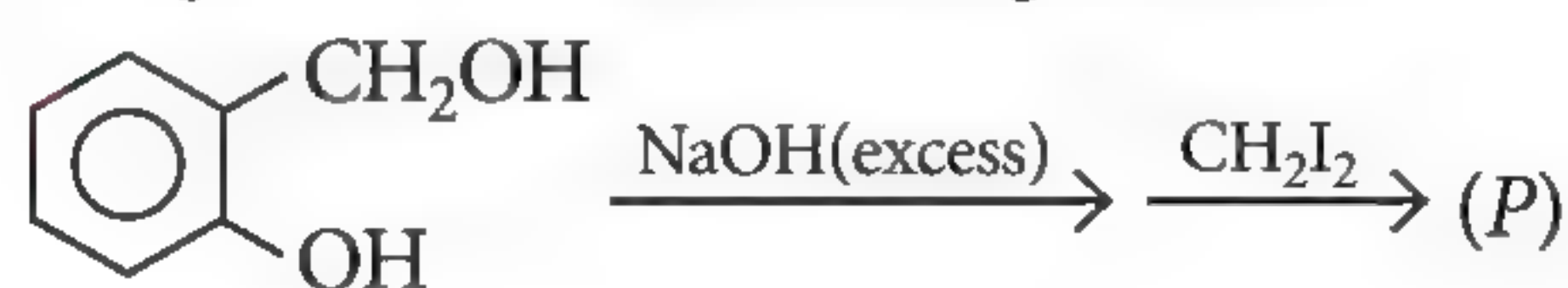
Negative Marks : -1 In all other cases.

1. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3 \xrightarrow[h\nu]{\text{Cl}_2} \text{A} + \text{B}$
(monochlorination products)

The approximate ratio of percentage yields of A and B formed in the above reaction is

- (a) 50 : 50 (b) 72 : 28
(c) 45 : 55 (d) 60 : 40
2. Two samples of DNA, A and B have melting points 340 K and 350 K respectively. This is because
- (a) B has more GC content than A
(b) A has more GC content than B
(c) B has more AT content than B
(d) Both have same AT content.

3. The product P of the following reaction is



4. The solubility products of $\text{Al}(\text{OH})_3$ and $\text{Zn}(\text{OH})_2$ are 8.5×10^{-23} and 1.8×10^{-14} respectively. If NH_4OH is added to a solution containing Al^{3+} and Zn^{2+} ions, then substance precipitated first is
- (a) $\text{Al}(\text{OH})_3$ (b) $\text{Zn}(\text{OH})_2$
(c) both together (d) none of these.

SECTION 2

- This section contains THREE (03) question stems.
- There are TWO (02) questions corresponding to each question stem.
- The answer to each question is a NUMERICAL VALUE.
- For each question, enter the correct numerical value corresponding to the answer in the designated place using the mouse and the on-screen virtual numeric keypad.
- If the numerical value has more than two decimal places, truncate/round-off the value to TWO decimal places.
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +2 If ONLY the correct numerical value is entered at the designated place

Zero Marks : 0 In all other cases.

Question Stem for Question Nos. 5 and 6

Question Stem

Let us consider 1 mole of gas. If it is an ideal gas then

$$\frac{P\bar{V}}{RT} = 1 \text{ where, } \bar{V} = \text{molar volume of a gas}$$

For a non-ideal gas this quotient may not equal to 1. It can also be less than or greater than 1. Therefore, the above quotient is defined as compressibility factor Z .

$$Z = \frac{P\bar{V}}{RT} = \frac{\text{Molar volume of real gas}}{\text{Molar volume of ideal gas}}$$

The compressibility factor of real gases can be written as

$$Z = \frac{P\bar{V}}{RT} = 1 + \frac{B}{\bar{V}} + \frac{C}{\bar{V}^2} + \frac{D}{\bar{V}^3} + \dots \quad (\text{Virial equation})$$

Where B , C , D are called virial coefficients and are dependent on the nature of the gas and temperature.

$B = \left(b - \frac{a}{RT}\right)$. At Boyle's temperature, second virial coefficient becomes zero. When $Z > 1$, repulsive forces are dominant and when $Z < 1$ the forces of attraction are dominant.

5. What is the value of Z for 0.02 mole of real gas at 0.1 atm pressure? Assuming the size of gas molecule negligible. (Given : $a = 1000 \text{ atm L}^2 \text{ mol}^{-2}$, $RT = 20 \text{ L atm mol}^{-1}$)
6. Compressibility factor for a gas at critical state is given as $\frac{x}{y}$. Then the value of $x + y$ is _____.

Question Stem for Question Nos. 7 and 8

Question Stem

A compound (P) is formed by heating xenon and fluorine in the molecular ratio of 1 : 20 under pressure in a nickel tube. (P) undergoes stepwise hydrolysis to yield final product (Q). (Q) is also formed when (P) is stored in glass vessel.

7. Number of fluorine atoms in P is _____.
8. If no. of lone pair around central atom in Q is x . Then value of x is _____.

Question Stem for Question Nos. 9 and 10

Question Stem

If a cell has cell potential ' E ' and standard cell potential E° then free energy change of cell process may be calculated as,

$$\Delta G = -W = -nFE$$

$$\Delta G^\circ = -W_{\max} = -nFE^\circ$$

Where, n is the number of electrons involved in overall cell process.

According to Gibbs-Helmholtz equation:

$$\Delta G = \Delta H - T\Delta S$$

$$\Delta G = \Delta H + T \left(\frac{d\Delta G}{dT} \right)_P$$

Temperature coefficient of cell ' μ ' will be equal to $\left(\frac{dE}{dT} \right)_P$.

9. ΔG° (in kJ) for the Daniell cell,
 $\text{Zn}_{(s)} | \text{ZnSO}_4 || \text{CuSO}_4 | \text{Cu}_{(s)}$
 $E^\circ_{\text{Zn}^{2+}/\text{Zn}} = -0.76 \text{ V}$; $E^\circ_{\text{Cu}^{2+}/\text{Cu}} = +0.34 \text{ V}$
 will be _____.

10. The temperature coefficient of a cell whose cell reaction is,



$$\left(\frac{dE}{dT} \right)_P = 1.5 \times 10^{-4} \text{ V K}^{-1} \text{ at } 298 \text{ K}$$

The change in entropy in $\text{J K}^{-1} \text{ mol}^{-1}$ for the given cell reaction will be _____.

SECTION 3

- This section contains SIX (06) questions.
 - Each question has FOUR options (a), (b), (c) and (d). ONE OR MORE THAN ONE of these four option(s) is (are) correct answer(s).
 - For each question, choose the option(s) corresponding to (all) the correct answer(s).
 - Answer to each question will be evaluated according to the following marking scheme:
- | | | |
|------------------|----|--|
| Full Marks : | +4 | If only (all) the correct option(s) is(are) chosen; |
| Partial Marks : | +3 | If all the four options are correct but ONLY three options are chosen; |
| Partial Marks : | +2 | If three or more options are correct but ONLY two options are chosen, both of which are correct; |
| Partial Marks : | +1 | If two or more options are correct but ONLY one option is chosen and it is a correct option; |
| Zero Marks : | 0 | If unanswered; |
| Negative Marks : | -2 | In all other cases. |
- For example, in a question, if (a), (b) and (d) are the ONLY three options corresponding to correct answers, then choosing ONLY (a), (b) and (d) will get +4 marks; choosing ONLY (a) and (b) will get +2 marks; choosing ONLY (a) and (d) will get +2 marks; choosing ONLY (b) and (d) will get +2 marks; choosing ONLY (a) will get +1 mark; choosing ONLY (b) will get +1 mark; choosing ONLY (d) will get +1 mark; choosing no option(s) (i.e., the question is unanswered) will get 0 marks and choosing any other option(s) will get -2 marks.

11. In which of the following species bond angle is expected to be more than 120° ?

- (a) PCl_4^+ (b) NO_2^-
(c) NO_2^+ (d) XeF_2

12. Which is/are wrong about P_4O_{10} molecule?

- (a) Each P atom can be considered to be sp^3 hybridised.
(b) There are four P—P bonds in the molecule.
(c) There are two types of P—O bond lengths.
(d) $\widehat{\text{POP}}$ angle is 180° .

13. For the energy levels in an atom, which one of the following statement/s is/are correct?

- (a) There are seven principal electron energy levels.
(b) The second principal energy level can have four sub-energy levels and contain a maximum of eight electrons.
(c) The M energy level can have a maximum of 32 electrons.
(d) The 4s sub-energy level is at a lower energy than the 3d sub-energy level.

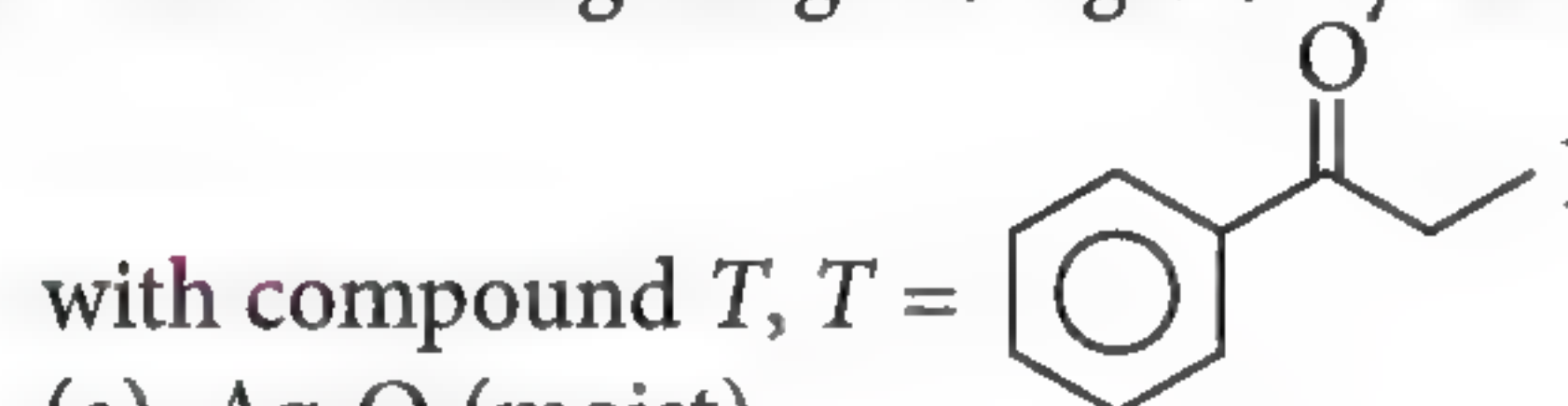
14. The correct IUPAC names of *di-tert* butyl ether are

- (a) 2-methyl-2-(2-methoxy-2-propoxy) propane
(b) 3-ethyl-2-methylcyclohex-1-ene
(c) 2-methyl-2-(1, 1-dimethyl ethoxy) propane
(d) 2, 2-dimethyl propoxy propane

15. In 0.020 M carbonic acid solution,

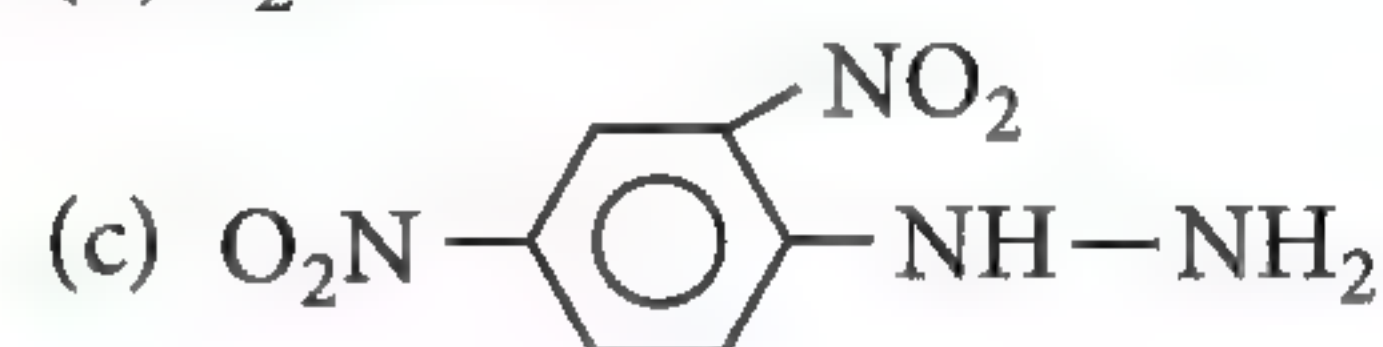
- (a) H_2CO_3 is stronger acid than water
(b) $\text{H}_2\text{CO}_3 \rightleftharpoons 2\text{H}^+ + \text{CO}_3^{2-}$, $K_{eq} = K_{a1} \cdot K_{a2}$
(c) $[\text{HCO}_3^-] \approx [\text{CO}_3^{2-}]$
(d) it can be said, $K_{a1} > K_w$

16. The following reagent/s give/s yellow precipitate



(a) Ag_2O (moist)

(b) I_2/NaOH



(d) $\text{AgNO}_3 + \text{NH}_4\text{OH}$

SECTION 4

- This section contains THREE (03) questions.
- The answer to each question is a NON-NEGATIVE INTEGER.
- For each question, enter the correct integer corresponding to the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +4 If ONLY the correct integer is entered;

Zero Marks : 0 In all other cases.

17. 6×10^{-3} mol $\text{K}_2\text{Cr}_2\text{O}_7$ reacts completely with 9×10^{-3} mol X^{n+} to give XO_3^- and Cr^{3+} . The value of 'n' is _____.

18. The number of electrons transferred when five moles of iodine is evolved from KI by KMnO_4 in acidic medium is _____.

19. 10 g of a mixture of hexane and ethanol are allowed to react with sodium to give 214.12 mL hydrogen at 27°C and 760 mm pressure. The percentage of ethanol in mixture is _____.

PAPER - II

SECTION 1

- This section contains SIX (06) questions.
- Each question has FOUR options (a), (b), (c) and (d). ONE OR MORE THAN ONE of these four option(s) is (are) correct answer(s).
- For each question, choose the option(s) corresponding to (all) the correct answer(s).
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +4 If only (all) the correct option(s) is(are) chosen;

Partial Marks : +3 If all the four options are correct but ONLY three options are chosen;

Partial Marks : +2 If three or more options are correct but ONLY two options are chosen, both of which are correct;

Partial Marks : +1 If two or more options are correct but ONLY one option is chosen and it is a correct option;

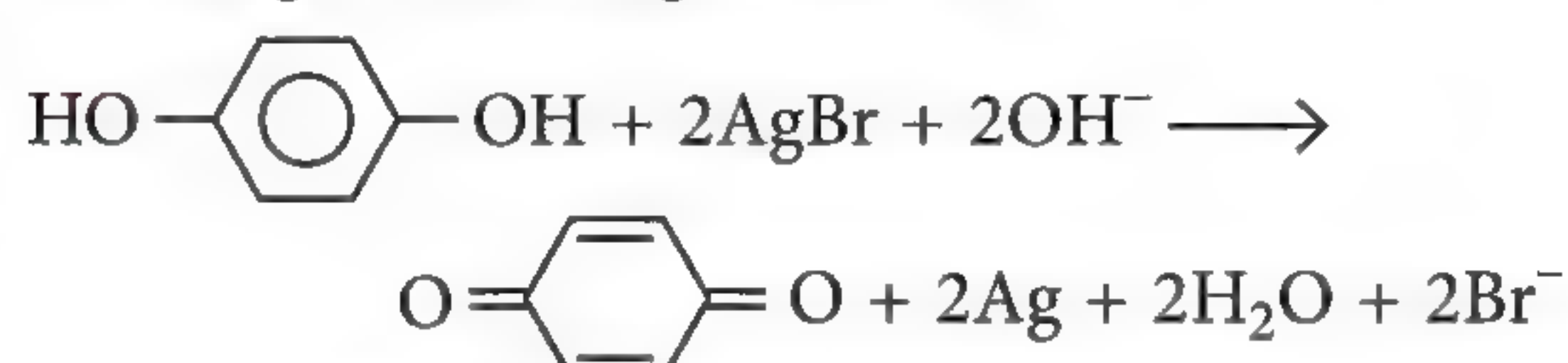
Zero Marks : 0 If unanswered;

Negative Marks : -2 In all other cases.

For example, in a question, if (a), (b) and (d) are the ONLY three options corresponding to correct answers, then

choosing ONLY (a), (b) and (d) will get +4 marks;
 choosing ONLY (a) and (b) will get +2 marks;
 choosing ONLY (a) and (d) will get +2 marks;
 choosing ONLY (b) and (d) will get +2 marks;
 choosing ONLY (a) will get +1 mark;
 choosing ONLY (b) will get +1 mark;
 choosing ONLY (d) will get +1 mark;
 choosing no option(s) (i.e. the question is unanswered) will get 0 marks and
 choosing any other option(s) will get -2 marks.

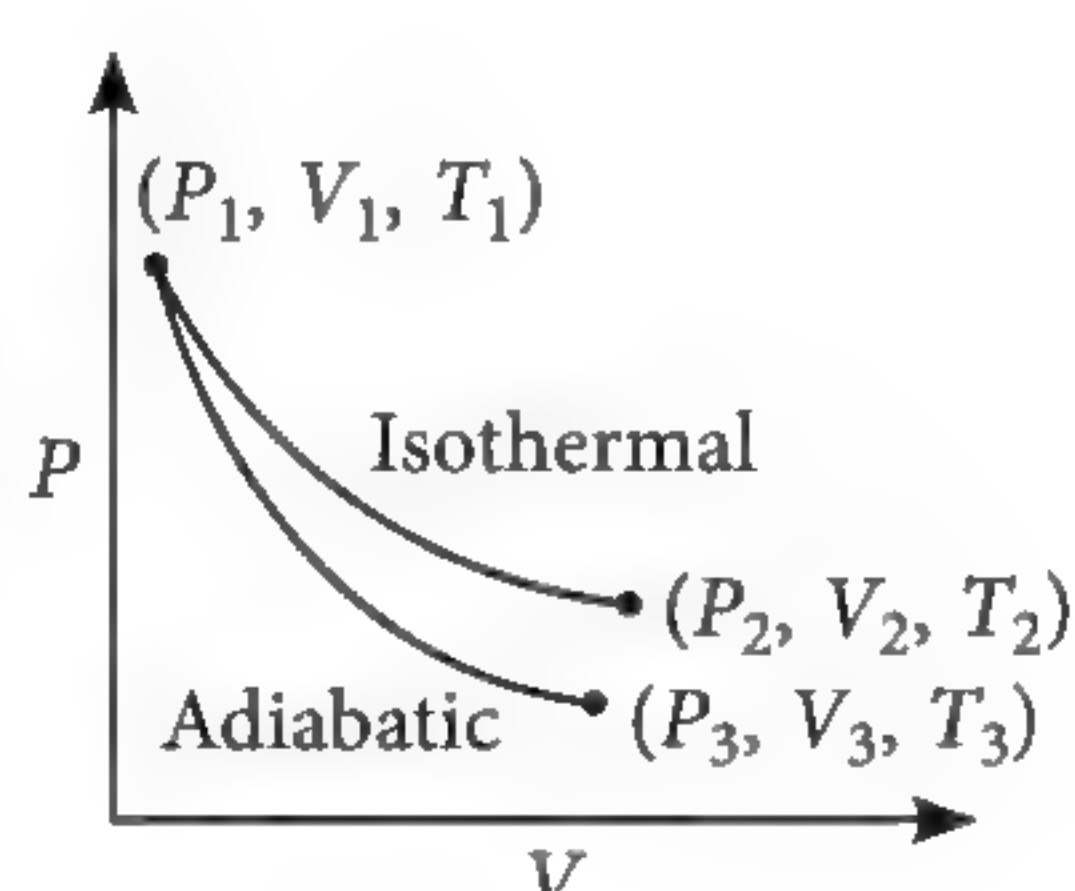
1. In photography, quinol is used as developer according to following reaction.



Which of the following describe(s) the role of quinol in this reaction?

- (a) It acts as an acid.
 (b) It acts as a weak base.
 (c) It acts as an oxidising agent.
 (d) It acts as a reducing agent.
2. Select correct statement(s).
 (a) Borax is used as a buffer.
 (b) 1 M borax solution reacts with equal volumes of 2 M HCl solution.
 (c) Titration of borax can be made using methyl orange as the indicator.
 (d) Coloured bead obtained in borax bead test contains metaborate.

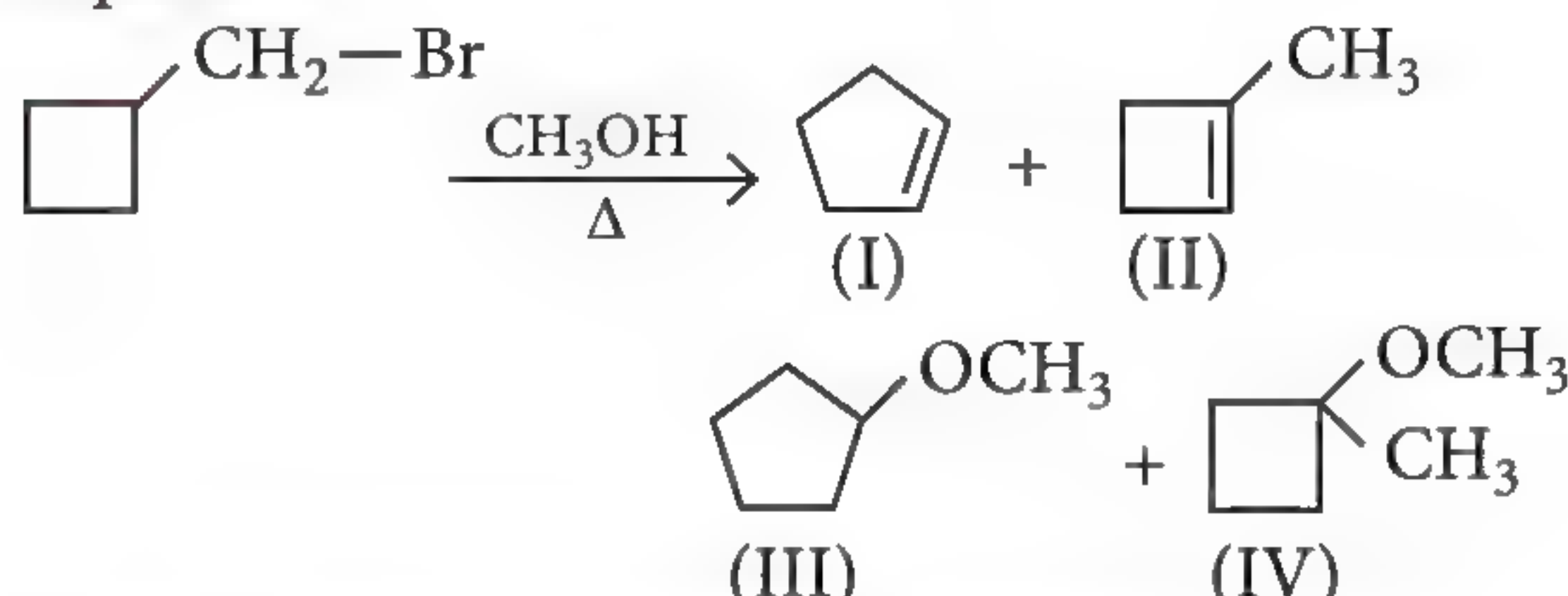
3. The reversible expansion of an ideal gas under adiabatic and isothermal conditions is shown in the figure. Which of the following statement(s) is (are) correct?



- (a) $T_1 = T_2$ (b) $T_3 > T_1$
 (c) $w_{\text{isothermal}} > w_{\text{adiabatic}}$
 (d) $\Delta U_{\text{isothermal}} > \Delta U_{\text{adiabatic}}$
4. When nitrobenzene is treated with Br_2 in presence of FeBr_3 , the major product formed is *m*-bromonitrobenzene. The statements which are related to obtain the *m*-isomer are
- (a) the electron density on meta carbon is more than at ortho and para-positions
 (b) the intermediate carbonium ion formed after initial attack of Br^+ at the *meta*-position is least destabilised

- (c) loss of aromaticity when Br^+ attacks at the ortho and *para* positions and not at *m*-position
 (d) easier loss of H^+ to regain aromaticity from the *meta*-position than from ortho and *para*-positions.

5. In the given reaction following products are expected.



Which observations seem to be correct?

- (a) I is the major product obtained by E1 reaction.
 (b) III is the major product obtained by $\text{S}_{\text{N}}1$ reaction.
 (c) Formation of II or IV involves a strained carbocation intermediate.
 (d) In the solvolysis reactions a carbocation intermediate is formed.
6. The complex ions which have *d* electrons in the central metal atom are
- (a) $[\text{MnO}_4]^-$ (b) $[\text{Co}(\text{NH}_3)_6]^{3+}$
 (c) $[\text{Fe}(\text{CN})_6]^{3-}$ (d) $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$

SECTION 2

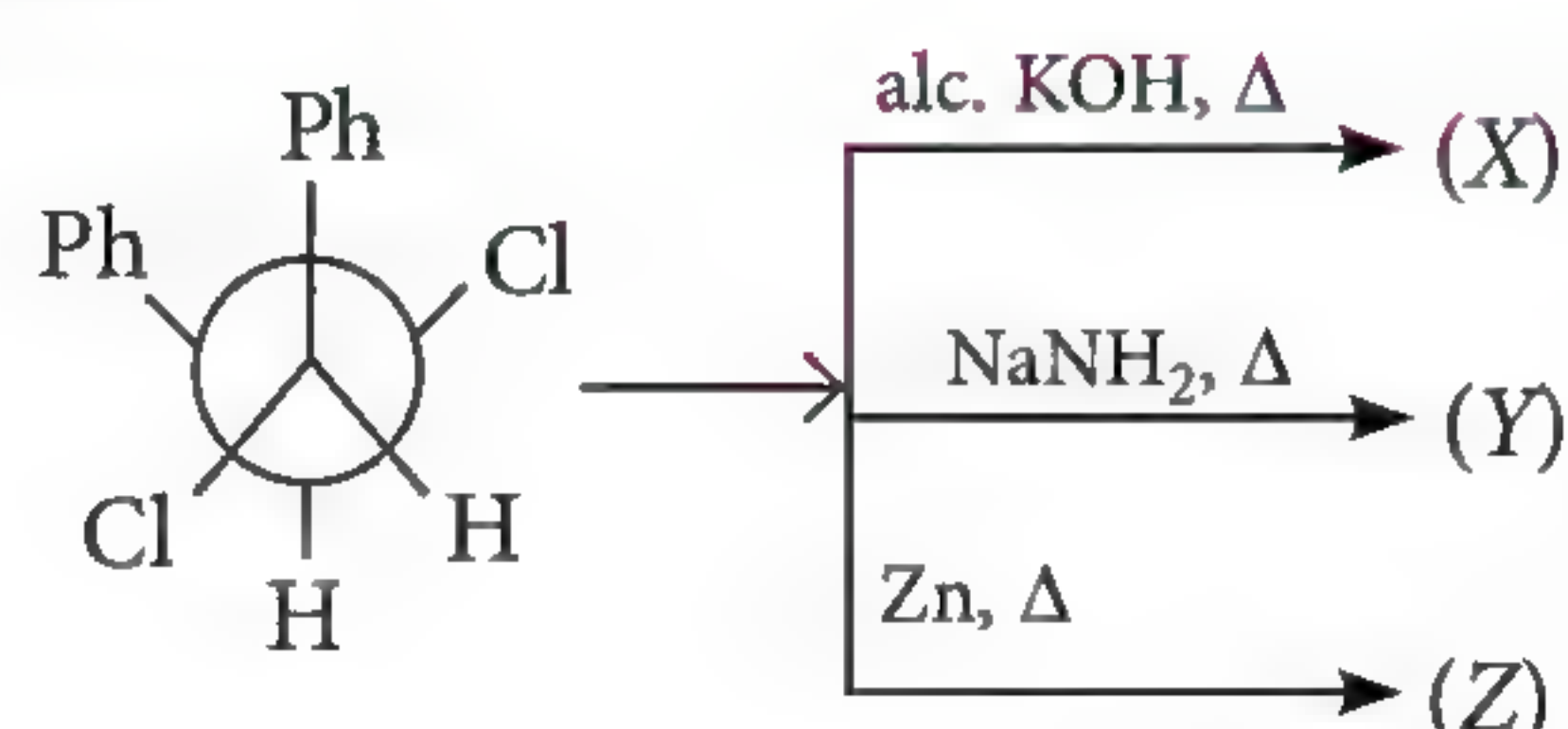
- This section contains THREE (03) question stems.
- There are TWO (02) questions corresponding to each question stem.
- The answer to each question is a NUMERICAL VALUE.
- For each question, enter the correct numerical value corresponding to the answer in the designated place using the mouse and the on-screen virtual numeric keypad.
- If the numerical value has more than two decimal places, truncate/round-off the value to TWO decimal places.
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +2 If ONLY the correct numerical value is entered at the designated place;

Zero Marks : 0 In all other cases.

Question Stem for Question Nos. 7 and 8

Question Stem



7. If number of phenyl groups in Z is a .
Then value of a is _____.
8. Number of Cl in Y is b . Then value of b is _____.

Question Stem for Question Nos. 9 and 10

Question Stem

A dihalogen derivative (A) of a hydrocarbon having two C-atoms react with alc. KOH and forms another hydrocarbon which gives a red ppt. with ammoniacal Cu_2Cl_2 . Compound (A) gives an aldehyde (B) when treated with aq. KOH.

9. If the IUPAC name of A is x, y - dichloro ethane then the value of $(x + y)$ is _____.
10. The number of carbon in the aldehyde is _____.

Question Stem for Question Nos. 11 and 12

Question Stem

Following data are given for the reaction between A and B.

$[A]/\text{mol L}^{-1}$	$[B]/\text{mol L}^{-1}$	Initial rate/mol $\text{L}^{-1} \text{s}^{-1}$ at 300 K
2.5×10^{-4}	3.0×10^{-5}	5.0×10^{-4}
5.0×10^{-4}	6.0×10^{-5}	4.0×10^{-3}
1.0×10^{-3}	6.0×10^{-5}	1.6×10^{-2}

11. If order with respect to A is x and with respect to B is y then value of $x + y$ is _____.
12. The rate constant at 300 K is $x \times 10^8$. Then the value of x is _____.

SECTION 3

- This section contains TWO (02) paragraphs. Based on each paragraph, there are TWO (02) questions.
- Each question has FOUR options (a), (b), (c) and (d). ONLY ONE of these four options is the correct answer.
- For each question, choose the option corresponding to the correct answer.
- Answer to each question will be evaluated according to the following marking scheme:
Full Marks : +3 If ONLY the correct option is chosen;
Zero Marks : 0 If none of the options is chosen (i.e., the question is unanswered);
Negative Marks : -1 In all other cases.

Paragraph-1

A univalent metal forms a binary compound X. 1.422 g of X reacts completely with 0.321 g sulphur to give 1.743 g of a white crystalline solid Y. Y forms a hydrated double salt with aluminium sulphate.

13. The metal forms the binary compound with
(a) H_2 (b) O_2 (c) S_2 (d) Cl_2 .
14. The hydrated double salt is
(a) $\text{K}_2\text{SO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}$

- (b) $\text{Na}_2\text{SO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}$
(c) $(\text{NH}_4)_2\text{SO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}$
(d) none of these.

Paragraph-2

An organic compound $\text{A}(\text{C}_4\text{H}_7\text{Cl}_3)$ yields (B) when treated with aq. KOH. (B) upon treatment with $\text{C}_2\text{H}_5\text{OH}$ in presence of acid gave (C) which upon reducing with LiAlH_4 gave (D) and (E). (B) upon treatment with NH_3 , followed by heating with P_4O_{10} and subsequent hydrolysis gives back (B). Sodium salt of (B) on Kolbe's electrolysis gave 2,3-dimethylbutane at anode.

15. Compound (B) can also be obtained by
(a) catalysed (HgSO_4) hydration of 1-butyne

- (b) reduction of $\text{CH}_3 - \underset{\text{CH}_3}{\text{CH}} - \overset{\text{O}}{\parallel} \text{COC}_2\text{H}_5$ with LiAlH_4
(c) oxidative cleavage of 4-methyl-2-pentene
(d) all the above.

16. Compounds (D) and (E) respectively are

- (a) $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$, $\text{C}_2\text{H}_5\text{OH}$
(b) $\text{CH}_3 - \underset{\text{CH}_3}{\text{CH}}\text{CH}_2\text{OH}$, $\text{C}_2\text{H}_5\text{OH}$
(c) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$, $\text{C}_2\text{H}_5\text{OH}$
(d) $\text{CH}_3 - \underset{\text{CH}_3}{\text{CH}}\text{CH}_2 - \text{OCH}_3$, CH_3OH .

SECTION 4

- This section contains THREE (03) questions.
- The answer to each question is a NON-NEGATIVE INTEGER.
- For each question, enter the correct integer corresponding to the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.
- Answer to each question will be evaluated according to the following marking scheme:
Full Marks : +4 If ONLY the correct integer is entered;
Zero Marks : 0 In all other cases.

17. 0.2 M NaNO_3 and 0.1 M $\text{Ca}(\text{NO}_3)_2$ solution are mixed in the ratio of $x : y$ such that in the resulting

MONTHLY TEST DRIVE CLASS XI ANSWER KEY

1. (c) 2. (c) 3. (a) 4. (a) 5. (b)
6. (d) 7. (c) 8. (d) 9. (d) 10. (b)
11. (b) 12. (c) 13. (a) 14. (b) 15. (d)
16. (b) 17. (d) 18. (a) 19. (b) 20. (a, d)
21. (a, b, c) 22. (a, b, c, d) 23. (a, c, d) 24. (7)
25. (3) 26. (4) 27. (b) 28. (c) 29. (c)
30. (a)

solution, the concentration of anions is 50% greater than that of cations. The value of $x + y$ is _____.

18. A diatomic molecule has a dipole moment of 1.2 D. If the bond distance is 1.0 Å, $1/x$ of an electronic charge exists on each atom. The value of x is _____.

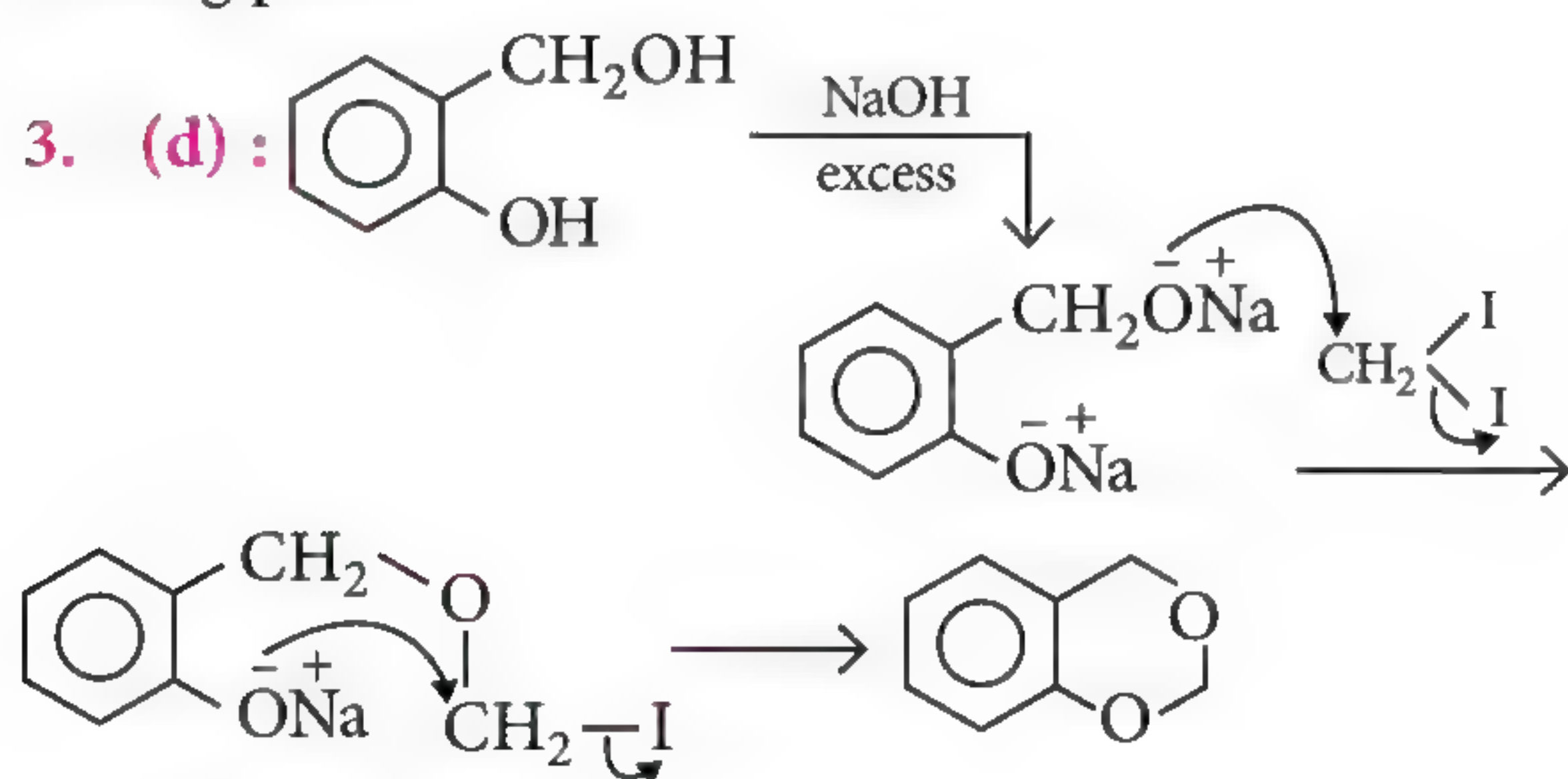
SOLUTIONS

PAPER - I

1. (b) : *n*-Butane has two types of H-atoms (six 1° and four 2°), therefore, it gives two monochloro-derivatives, i.e., 2-chlorobutane (A) and 1-chlorobutane (B). Their relative percentage yields are

$$\frac{\text{Amount of A}}{\text{Amount of B}} = \frac{4}{6} \times \frac{3.8}{1.0} = \frac{15.2}{6.0} = \frac{72\%}{28\%}$$

2. (a) : Since GC base pair having three H-bonds so it is more stable than AT base pair having two H-bonds, therefore, DNA with higher GC content will have higher melting point.



4. (a) :

5. (0.01) : $\left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT$

$$\left[0.1 + \frac{1000 \times (0.02)^2}{V^2}\right] V = 20 \times 0.02$$

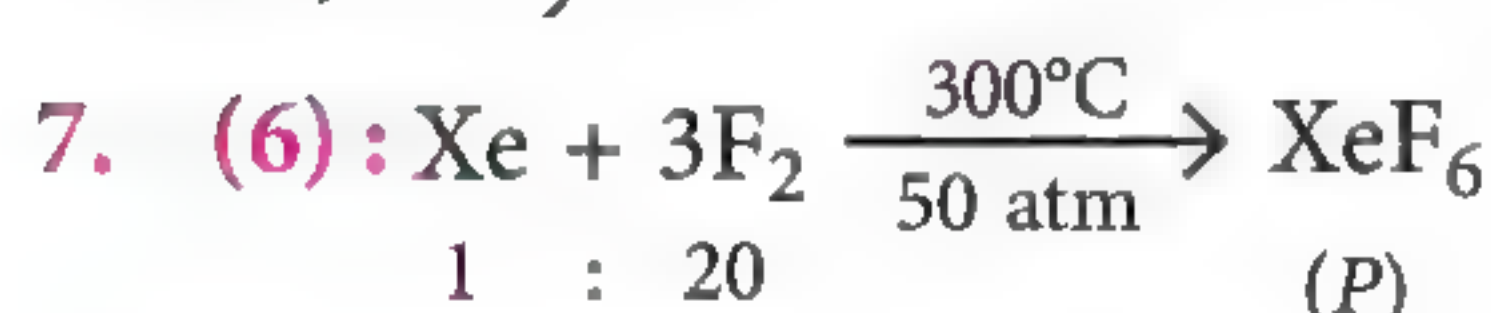
Here, $b = 0$, since size of the gas molecule is negligible. On solving above equation

$$V = 2 \text{ L}$$

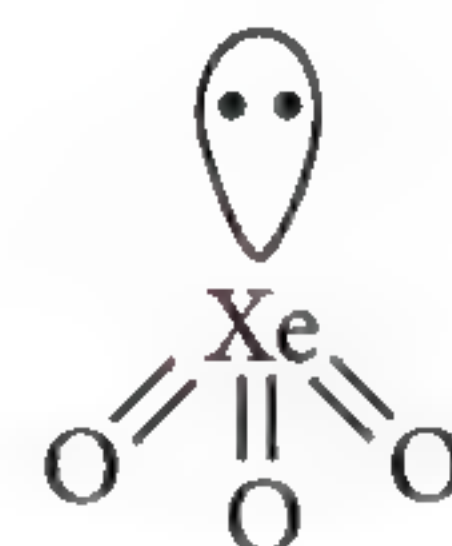
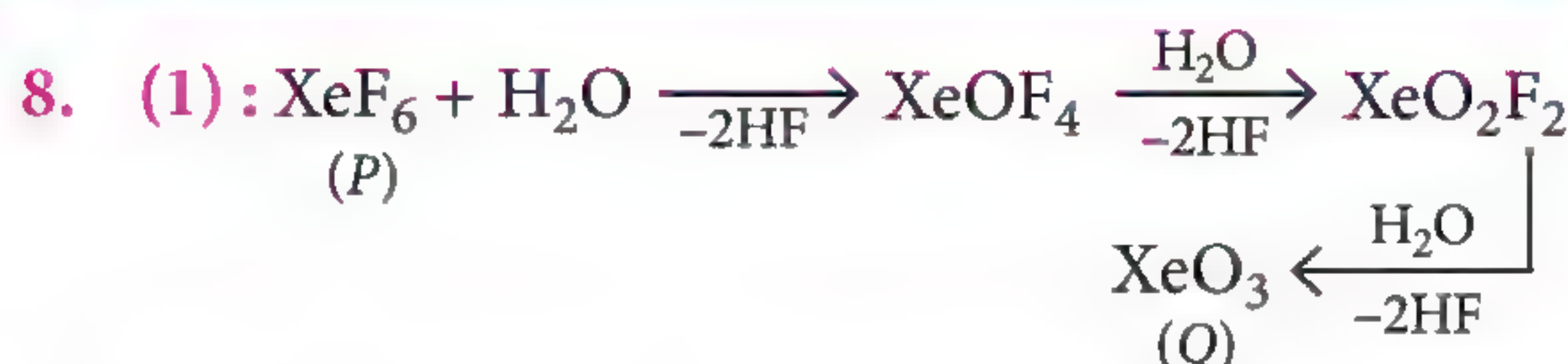
$$Z = \frac{PV}{RT} = \frac{0.1 \times 2}{20} = 0.01$$

6. (11) : Compressibility factor for a gas at critical state is $\frac{3}{8}$.

$$\text{So, } x + y = 11.$$



19. Monoclinic gypsum $\xrightarrow{\Delta}$ Orthorhombic gypsum
 $\xrightarrow{\Delta}$ Plaster of Paris $\xrightarrow{200^\circ\text{C}}$ Burnt plaster
 $\xrightarrow[\text{Heated}]{\text{Strongly}}$ No. of compounds obtained is _____.

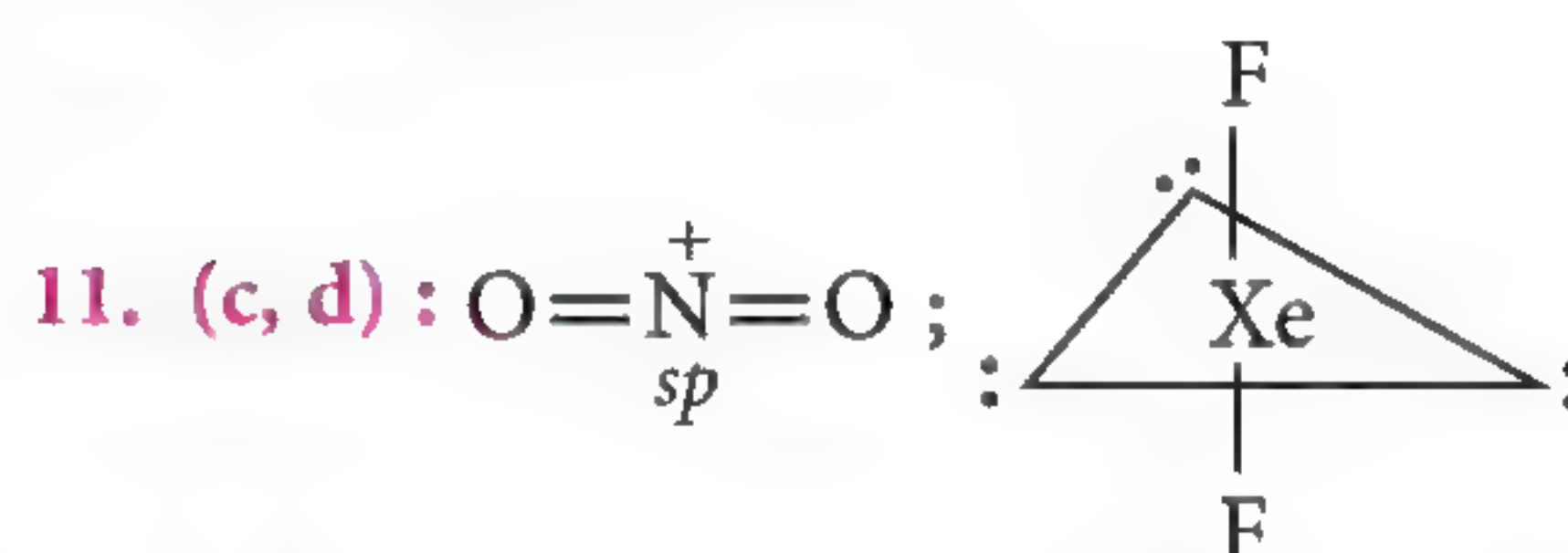


In (Q), i.e., XeO_3 , there are 3 π -bonds and Xe is sp^3 hybridised. XeO_3 has in all 7 electron pairs, out of which there is 1 lone pair around central atom.

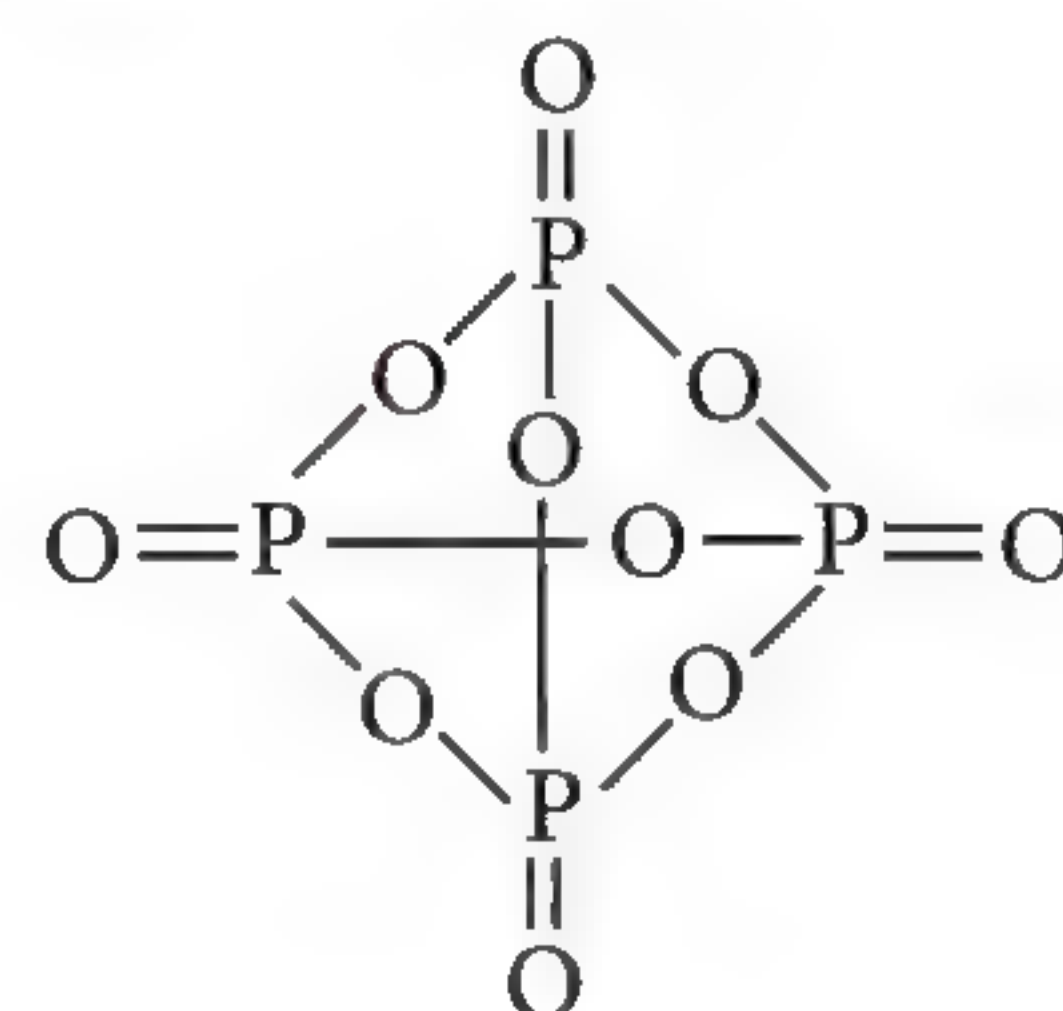
9. (212.3) : $E^\circ = E^\circ_{\text{Cu}^{2+}/\text{Cu}} - E^\circ_{\text{Zn}^{2+}/\text{Zn}}$
 $= 0.34 - (-0.76) = 1.1 \text{ V}$
 $\Delta G^\circ = -nFE^\circ$
 $= -2 \times 96500 \times 1.10 = -212300 \text{ J} = -212.3 \text{ kJ}$

10. (28.95) : $\left(\frac{dE}{dT}\right)_P = \frac{\Delta S}{nF}$
 $1.5 \times 10^{-4} = \frac{\Delta S}{2 \times 96500}$

$$\Delta S = 28.95 \text{ J K}^{-1} \text{ mol}^{-1}$$

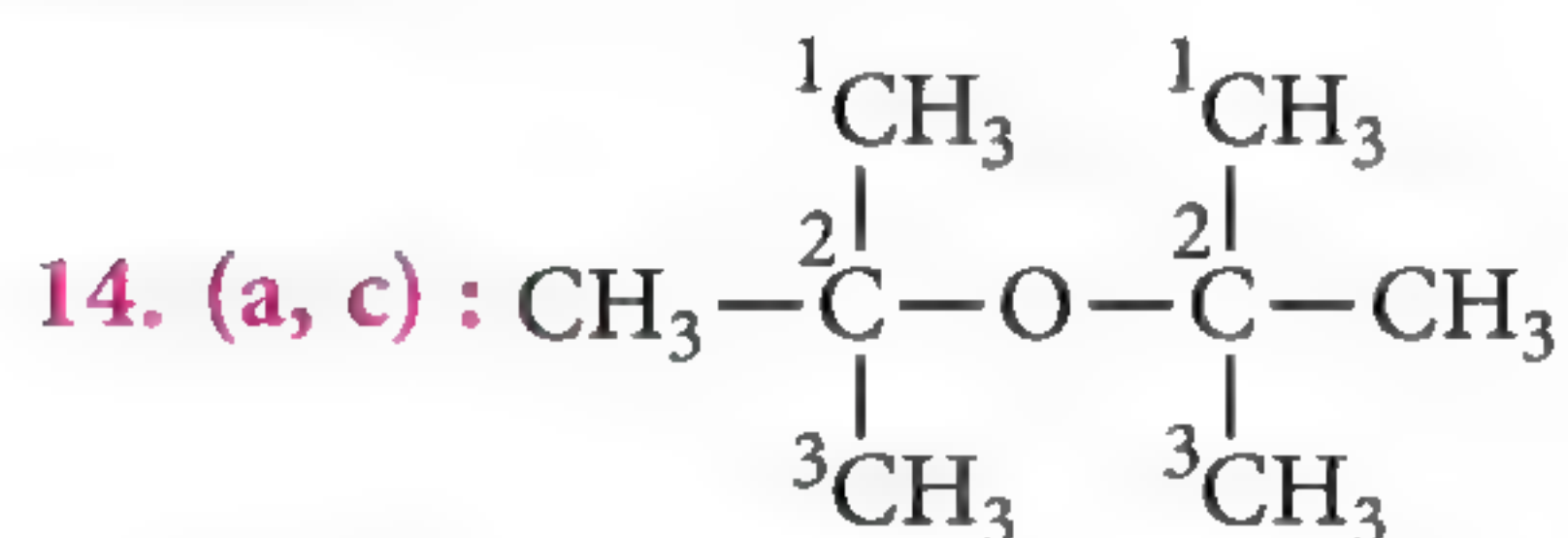


12. (b, d) : P_4O_{10} does not contain P—P bonds rather there are $\text{P}=\text{O}$ bonds.



13. (a, d) : (a) and (d) are true, (b) is wrong because for $n = 2, l = 0, 1$ (two sub-energy levels). (c) is wrong

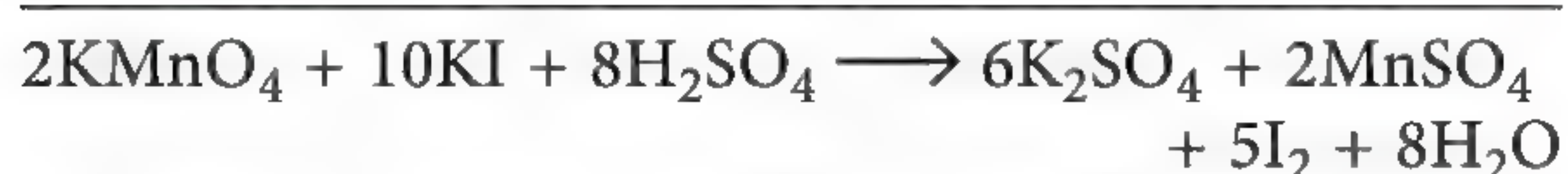
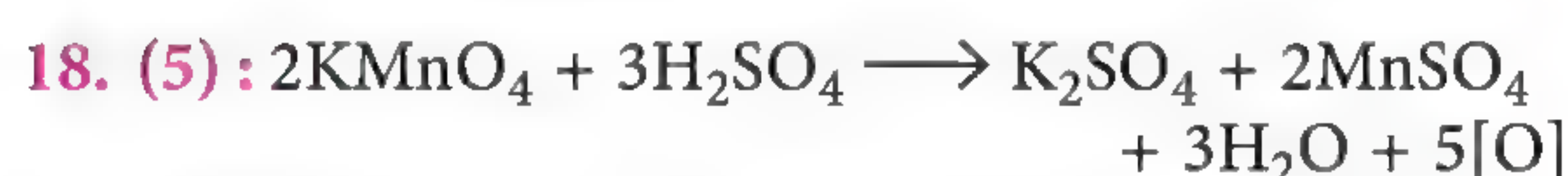
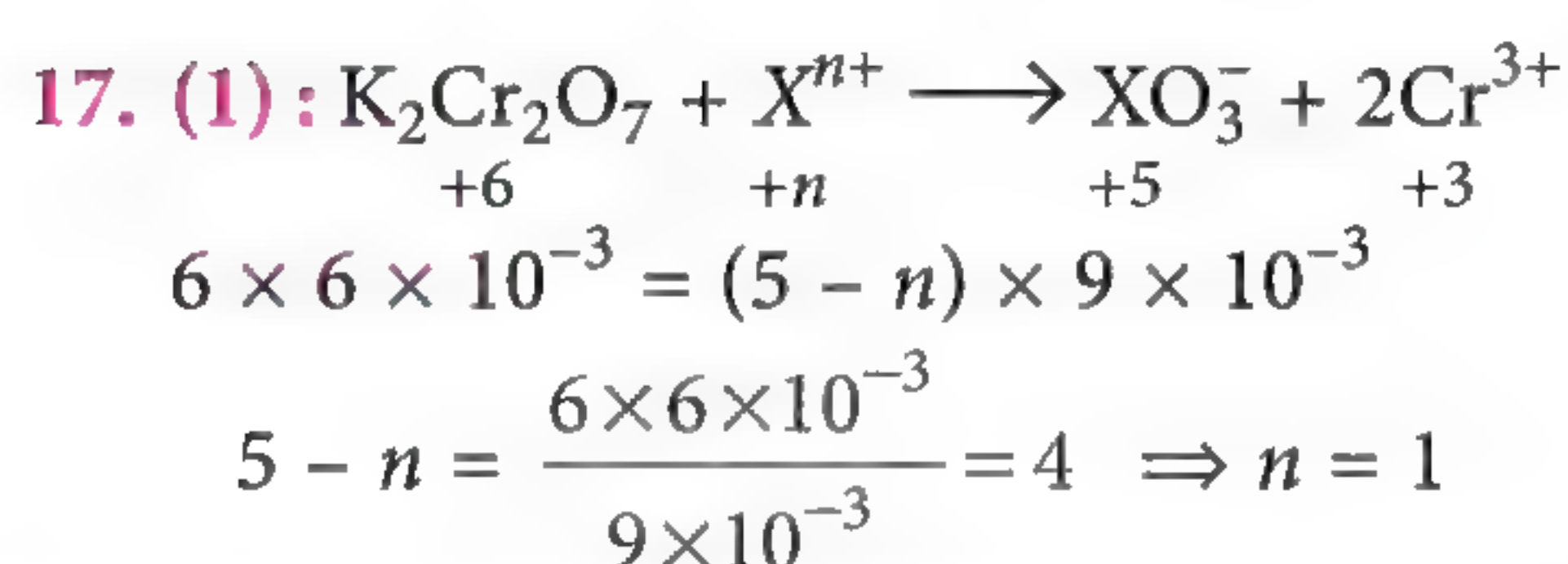
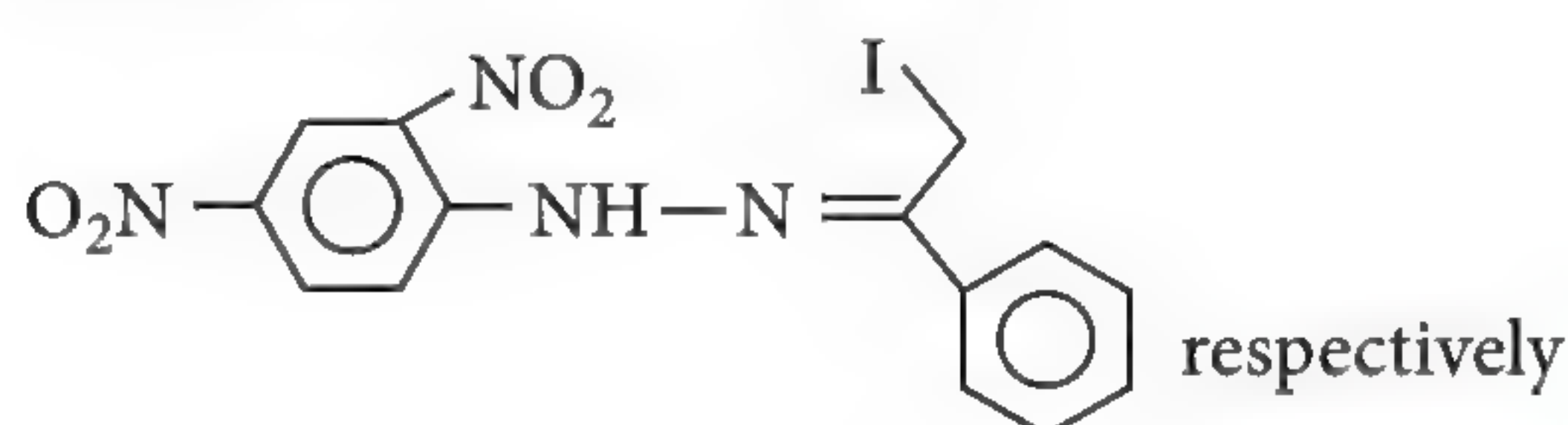
because M shell means $n = 3$. Maximum electrons it can have $= 2n^2 = 2 \times 3^2 = 18$.



2-Methyl-2-(2-methyl-2-propoxy) propane
or 2-Methyl-2-(1, 1-dimethylethoxy) propane

15. (a, b, d) : As H_2CO_3 undergoes dissociation in water it means $K_{a1} \gg K_w$.
 HCO_3^- is a very poor acid.

16. (b, c) : In (b) and (c) the corresponding yellow precipitates are of CHI_3 and



or $2\text{MnO}_4^- + 10\text{I}^- + 16\text{H}^+ \longrightarrow 2\text{Mn}^{2+} + 5\text{I}_2 + 8\text{H}_2\text{O}$
In the above reaction, MnO_4^- has Mn in +7 O.S. and Mn in product side is in +2 O.S., thus the reaction involves the transfer of 5 electrons.

19. (8) : The given mixture (hexane + ethanol) weighs 10 g.

The mixture reacts with Na to give 214.2 mL hydrogen at 27°C and 760 mm pressure.

Only ethanol evolves hydrogen and thus
 $\text{C}_2\text{H}_5\text{OH} + \text{Na} \longrightarrow \text{C}_2\text{H}_5\text{O}^- \text{Na}^+ + 1/2\text{H}_2$

No. of moles of H_2 formed

$$= \frac{PV}{RT} = \frac{1 \times 214.2}{1000 \times 0.0821 \times 300} = 8.69 \times 10^{-3} \text{ moles}$$

1/2 mole of H_2 is formed from 46 g ethanol

$\therefore 8.69 \times 10^{-3}$ moles are formed from

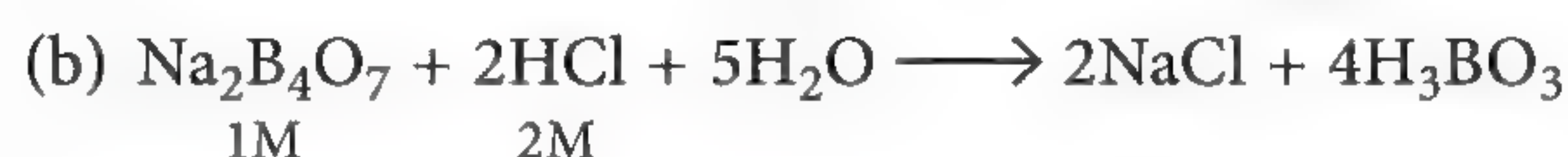
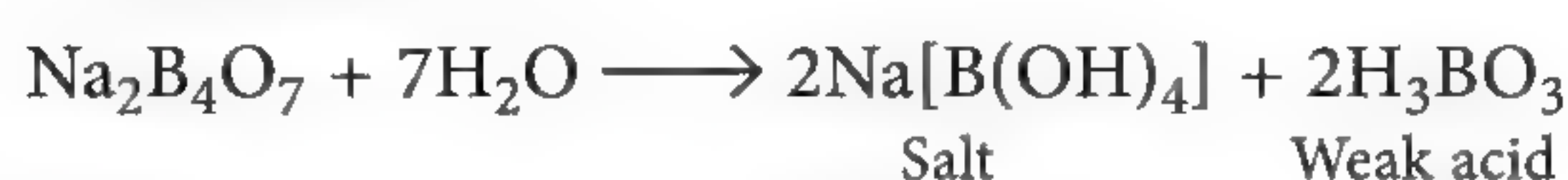
$$\frac{46 \times 8.69 \times 10^{-3}}{1/2} = 0.8 \text{ g C}_2\text{H}_5\text{OH}$$

$$\therefore \% \text{ of ethanol in mixture} = \frac{0.8 \times 100}{10} = 8\%$$

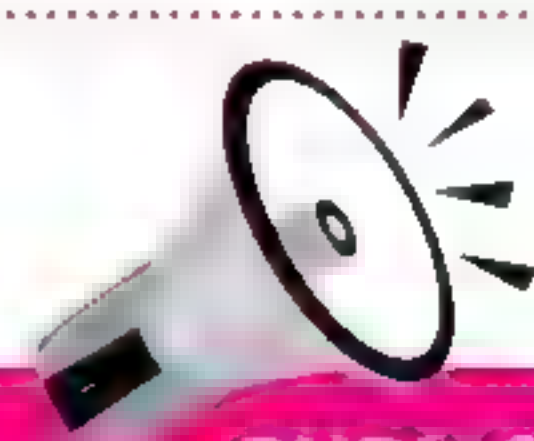
PAPER - II

1. (a, d) : Quinol is acting as an acid. It is donating H^+ ions and also acts as a reducing agent to convert Ag^+ to Ag.

2. (a, b, d) : (a) Borax solution in water produces weak acid H_3BO_3 and its salt $\text{Na}[\text{B}(\text{OH})_4]$ which exert a buffer action.



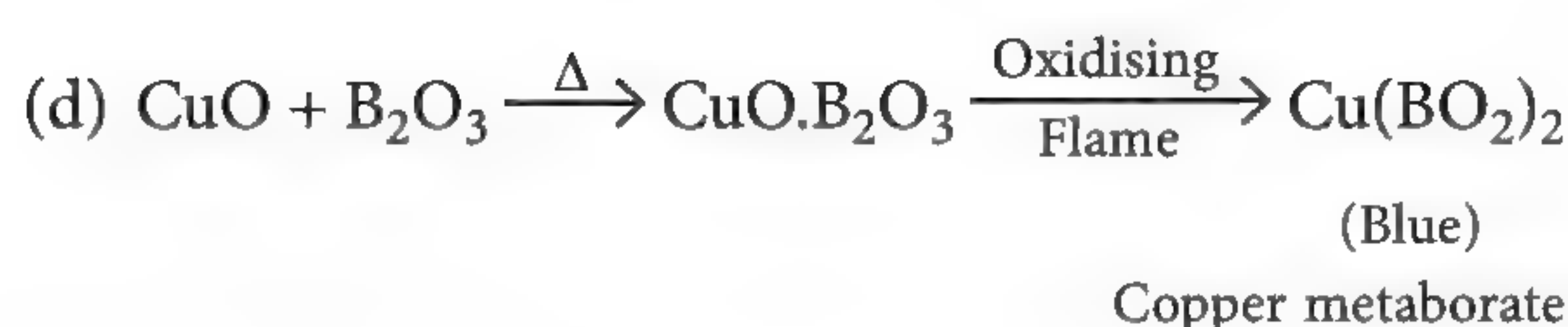
(c) Borax cannot be titrated using methyl orange as indicator



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S. No.	Activity	Day, Date and Time (IST)
1.	JEE Main 2022 (Computer based test by NTA)	Please refer to JEE (Main) 2022 website
2.	Results JEE Main 2022 from NTA	Please refer to JEE (Main) 2022 website
3.	Registration for JEE (Advanced) 2022	Sunday, August 07, 2022 (10:00 IST) to Thursday, August 11, 2022 (17:00 IST)
4.	Last date for fee payment of registered candidates	Friday, August 12, 2022 (17:00 IST)
5.	Admit Card available for downloading	Tuesday, August 23, 2022 (10:00 IST) to Sunday, August 28, 2022 (14:30 IST)
6.	Choosing of scribe by PwD candidates	Saturday, August 27, 2022
7.	JEE (Advanced) 2022	Sunday, August 28, 2022 Paper 1: 09:00-12:00 IST Paper 2: 14:30-17:30 IST
8.	Copy of candidate responses to be available on the JEE (Advanced) 2022 website	Thursday, September 01, 2022 (10:00 IST)
9.	Online display of provisional answer keys	Saturday, September 03, 2022 (10:00 IST)
10.	Feedback and comments on provisional answer keys from the candidates	Saturday, September 03, 2022 (10:00 IST) to Sunday, September 04, 2022 (17:00 IST)
11.	Online declaration of final answer keys	Sunday, September 11, 2022 (10:00 IST)
12.	Result of JEE (Advanced) 2022	Sunday, September 11, 2022 (10:00 IST)
13.	Online registration for Architecture Aptitude Test (AAT) 2022	Sunday, September 11, 2022 (10:00 IST) to Monday, September 12, 2022 (17:00 IST)
14.	Tentative Start of Joint Seat Allocation (JoSAA) 2022 Process	Monday, September 12, 2022
15.	Architecture Aptitude Test (AAT) 2022	Wednesday, September 14, 2022 (09:00-12:00 IST)
16.	Declaration of results of AAT 2022	Saturday, September 17, 2022 (17:00 IST)

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3. (a, c, d) : (a) $T_1 = T_2$ as the process is isothermal. Hence, (a) is correct.

(b) $T_3 < T_1$ because cooling takes place on adiabatic expansion. Hence, (b) is incorrect.

(c) $w_{\text{isothermal}} > w_{\text{adiabatic}}$ because area under the isothermal curve is greater than under the adiabatic curve.

Hence (c) is correct.

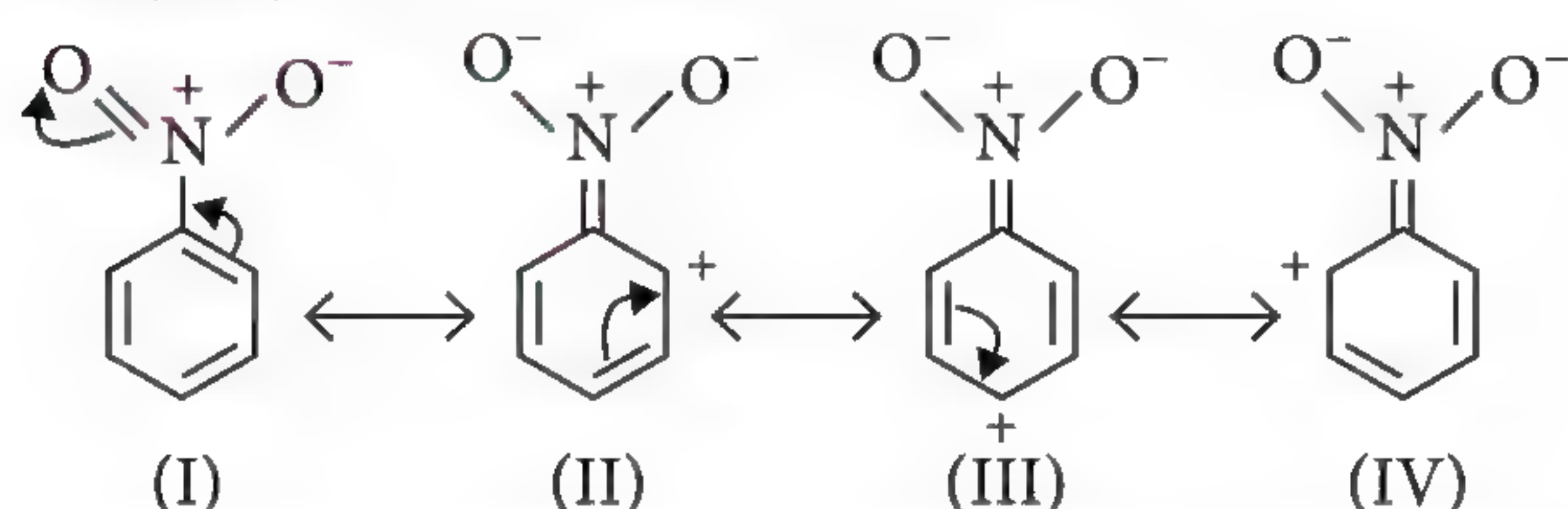
(d) $\Delta U_{\text{isothermal}} = 0$ (as T remains constant)

$\Delta U_{\text{adiabatic}} = -ve$ because when adiabatic expansion occurs, internal energy decreases.

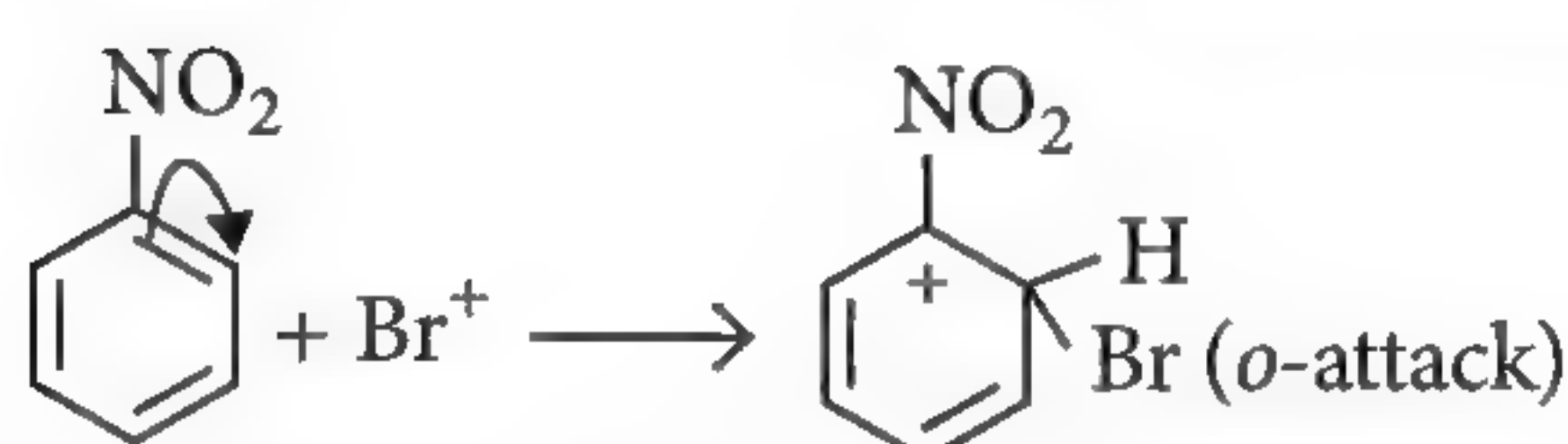
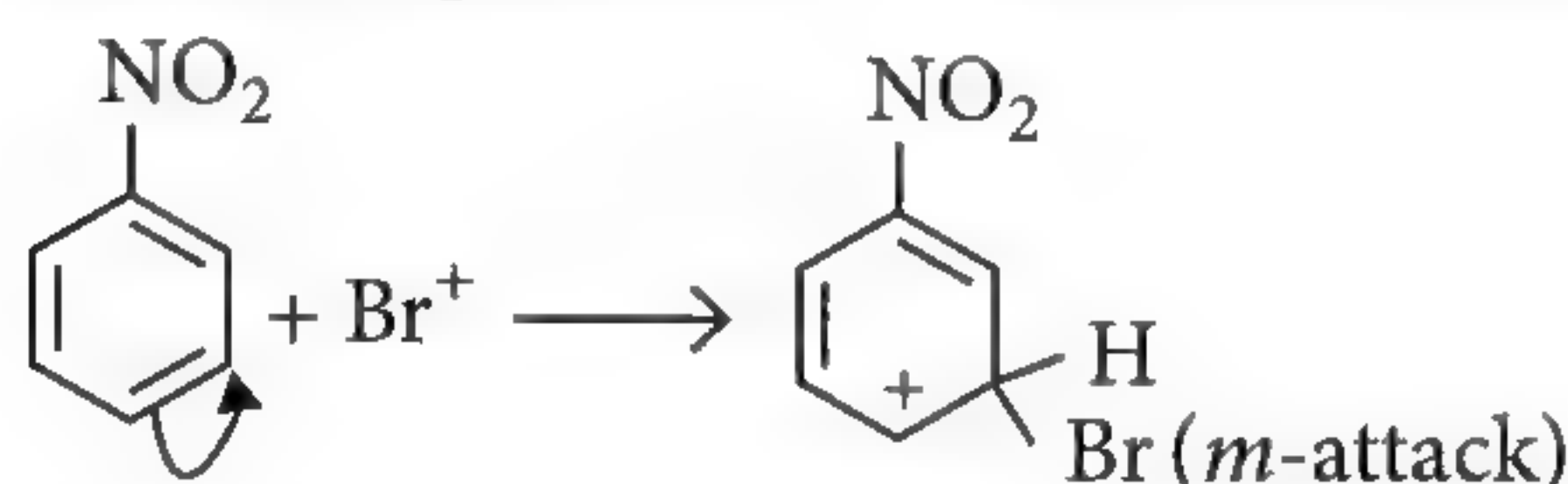
Thus, $\Delta U_{\text{isothermal}} > \Delta U_{\text{adiabatic}}$

Hence, (d) is correct.

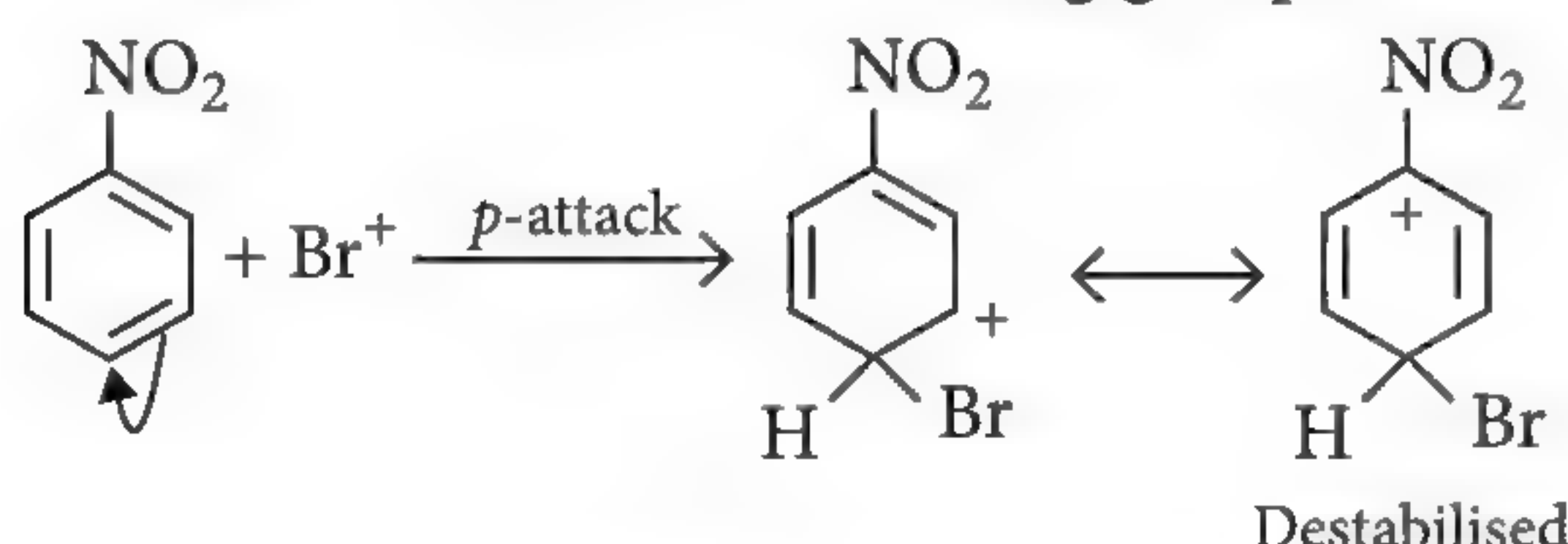
4. (a, b) : Resonance in nitrobenzene



Nitro-group because of electron withdrawing nature reduces electron density more at *o*- and *p*-positions than at *m*-position. If we write the mechanism

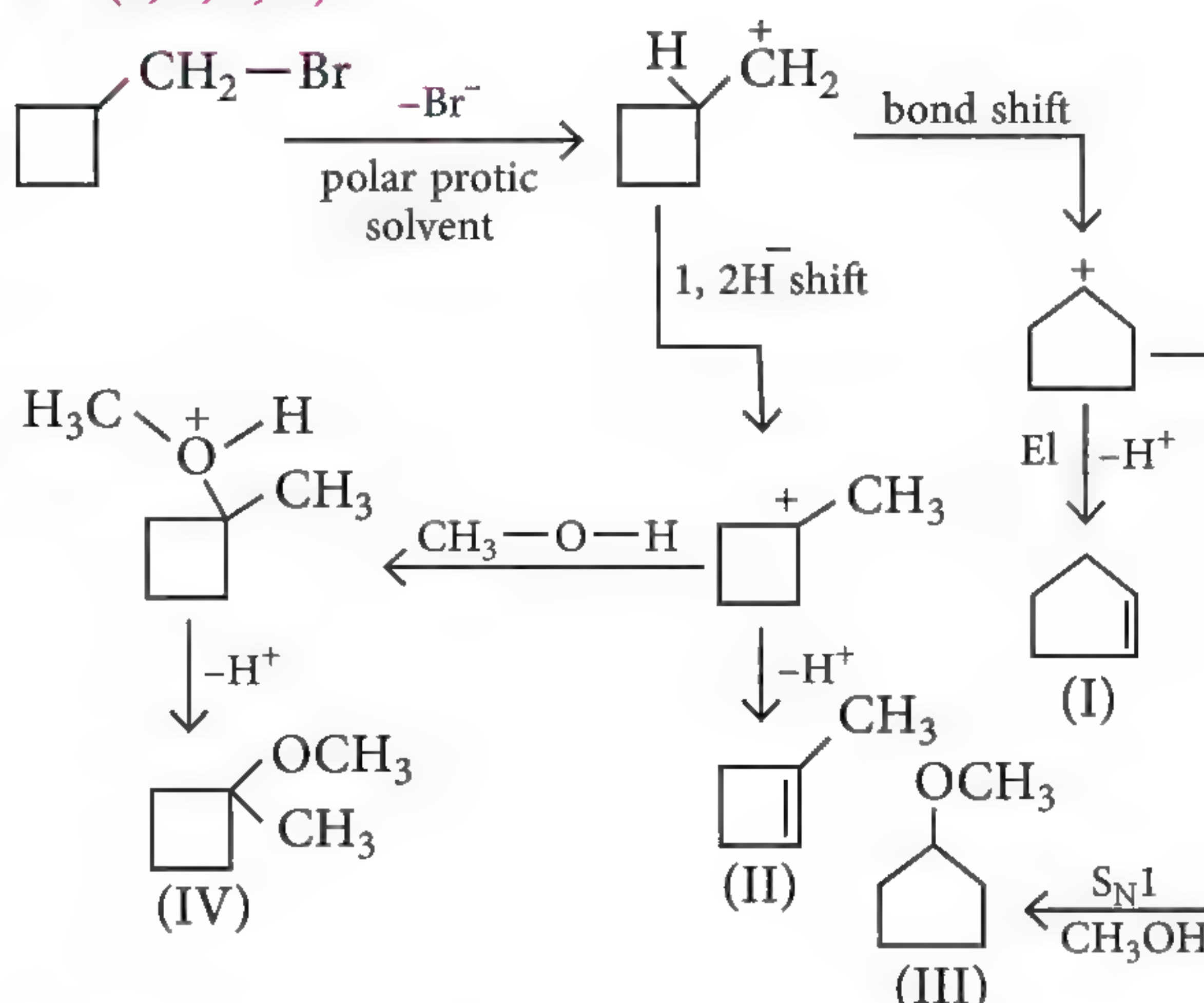


(destabilised because +ve charge is on the carbon attached to electron withdrawing group).



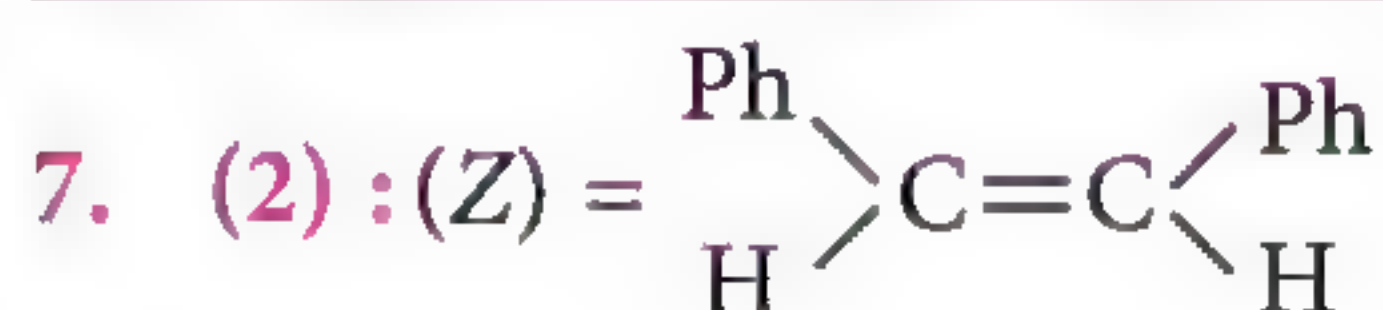
Thus, the intermediate carbocation formed after the initial attack of Br^+ at the *meta*-positions is least destabilised.

5. (a, b, c, d) :

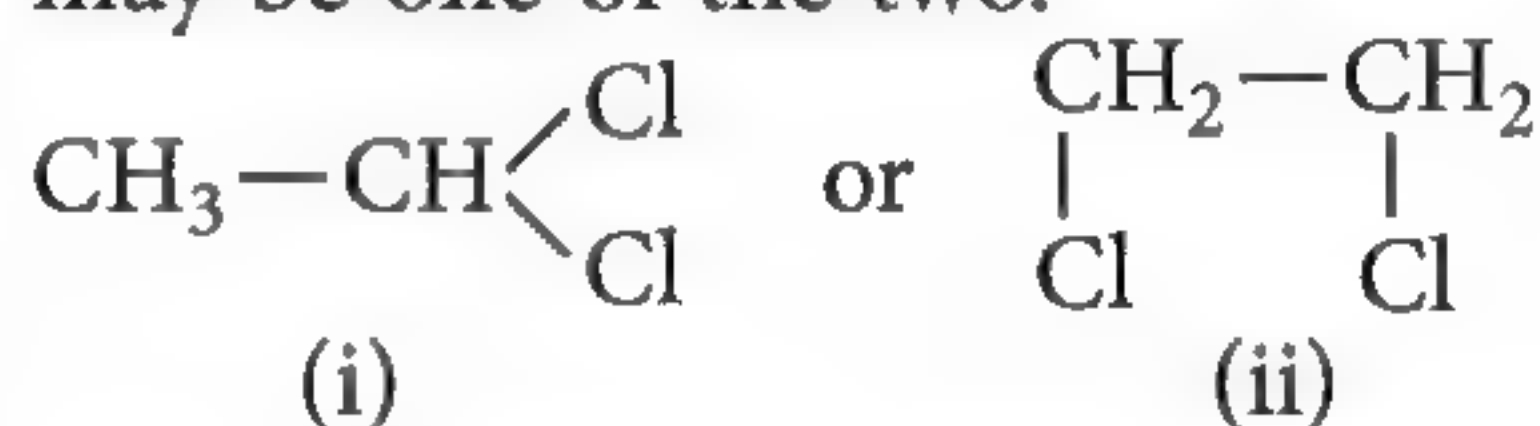


6. (b, c, d) :

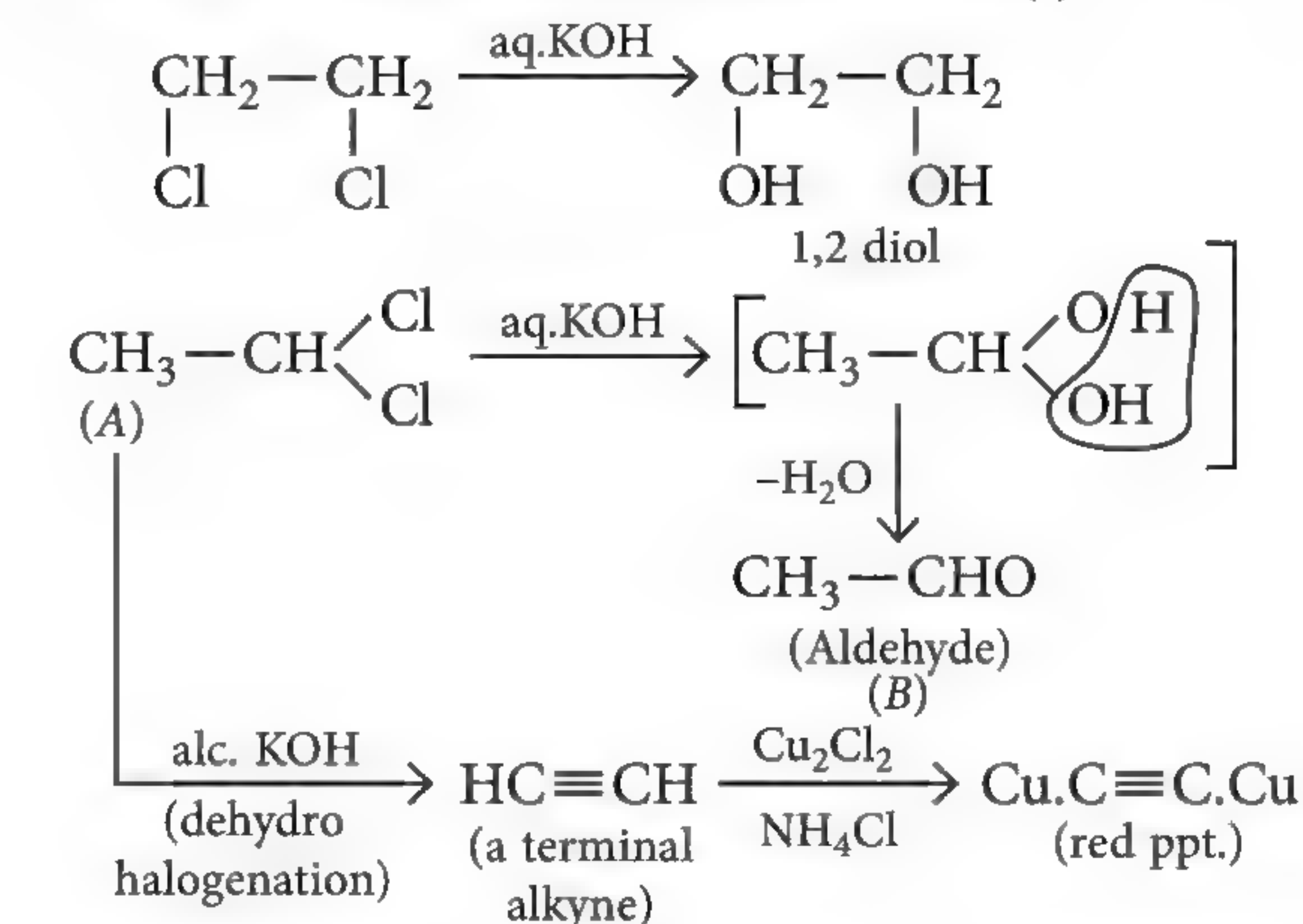
Central atom	Oxidation state	No. of electrons	Configuration
Mn	+7	$25 - 7 = 18$	$1s^2 2s^2 2p^6 3s^2 3p^6$
Co	+3	$27 - 3 = 24$	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^6$
Fe	+3	$26 - 3 = 23$	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^5$
Cr	+3	$24 - 3 = 21$	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^3$



9. (2) : Since compound (A) is a dihalogen derivative of a hydrocarbon having two carbon atoms, hence it may be one of the two.



Only (i) gives an aldehyde with aq. KOH, (ii) gives 1,2 diol, hence correct structure of A is (i).



Hence, A is $\text{CH}_3-\text{CHCl}_2$, that is, 1,1-dichloroethane.

10. (2)

11. (3) : Let x and y be the orders of the reaction with respect to A and B respectively. We will have

$$r_0 = k[A]_0^x [B]_0^y$$

From second and third data, we get

$$4.0 \times 10^{-3} \text{ M s}^{-1} = k[5.0 \times 10^{-4} \text{ M}]^x [6.0 \times 10^{-5} \text{ M}]^y$$

$$1.6 \times 10^{-2} \text{ M s}^{-1} = k[1.0 \times 10^{-3} \text{ M}]^x [6.0 \times 10^{-5} \text{ M}]^y$$

Dividing the two expressions, we get

$$\frac{1.6 \times 10^{-2}}{4.0 \times 10^{-3}} = \left[\frac{1.0 \times 10^{-3}}{5.0 \times 10^{-4}} \right]^x$$

$$\text{i.e. } 4 = 2^x.$$

Hence, $x = 2$.

From the first and second data, we write,

$$5.0 \times 10^{-4} \text{ M s}^{-1} = k[2.5 \times 10^{-4} \text{ M}]^2 [3.0 \times 10^{-5} \text{ M}]^y$$

$$4.0 \times 10^{-3} \text{ M s}^{-1} = k[5.0 \times 10^{-4} \text{ M}]^2 [6.0 \times 10^{-5} \text{ M}]^y$$

Dividing these two expressions, we get

$$\frac{4.0 \times 10^{-3}}{5.0 \times 10^{-4}} = \left(\frac{5.0 \times 10^{-4}}{2.5 \times 10^{-4}} \right)^2 \left(\frac{6.0 \times 10^{-5}}{3.0 \times 10^{-5}} \right)^y$$

$$\text{i.e. } 8 = 2^2 \cdot 2^y$$

Hence, $y = 1$.

Thus, the order of the reaction with respect to A and B are 2 and 1 respectively.

$$x + y = 2 + 1 = 3$$

12. (2.67) : The rate constant is $k = \frac{r_0}{[A]_0^2 [B]_0}$

From the first data at 300 K, we get

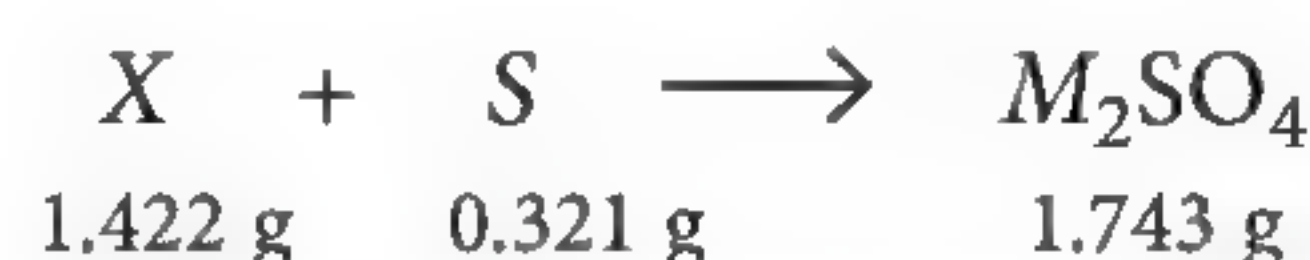
$$k = \frac{5.0 \times 10^{-4} \text{ Ms}^{-1}}{(2.5 \times 10^{-4} \text{ M})^2 (3.0 \times 10^{-5} \text{ M})}$$

$$= 2.67 \times 10^8 \text{ M}^{-2} \text{ s}^{-1}.$$

13. (b) : Since Y forms a hydrated double salt with $\text{Al}_2(\text{SO}_4)_3$ the structure of double salt may be



Hence Y may be a sulphate of the univalent metal. The reaction of X with sulphur may be written as



Hence, the compound X must be $M_2\text{O}_4$, i.e. 2MO_2 .

The metal M may be identified from the given data of masses of MO_2 , S and $M_2\text{SO}_4$. If M' is the molar mass of the metal M , we have molar mass of $\text{MO}_2 = M' + 2 \times 16 \text{ g mol}^{-1}$

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Now 0.321 g of S reacts with 1.422 g of MO_2 . The mass of MO_2 that reacts with 32 g of S (= 1 molar mass of S) is

$$\frac{1.422 \text{ g}}{0.321 \text{ g}} \times 32 \text{ g} = 141.75 \text{ g}$$

This will be equal to the twice of molar mass of MO_2 .
Hence, $2(M' + 2 \times 16) \text{ g mol}^{-1} \approx 141.75 \text{ g mol}^{-1}$

$$\text{or } M = \left(\frac{141.75}{2} - 2 \times 16 \right) \text{ g mol}^{-1} \approx 39 \text{ g mol}^{-1}$$

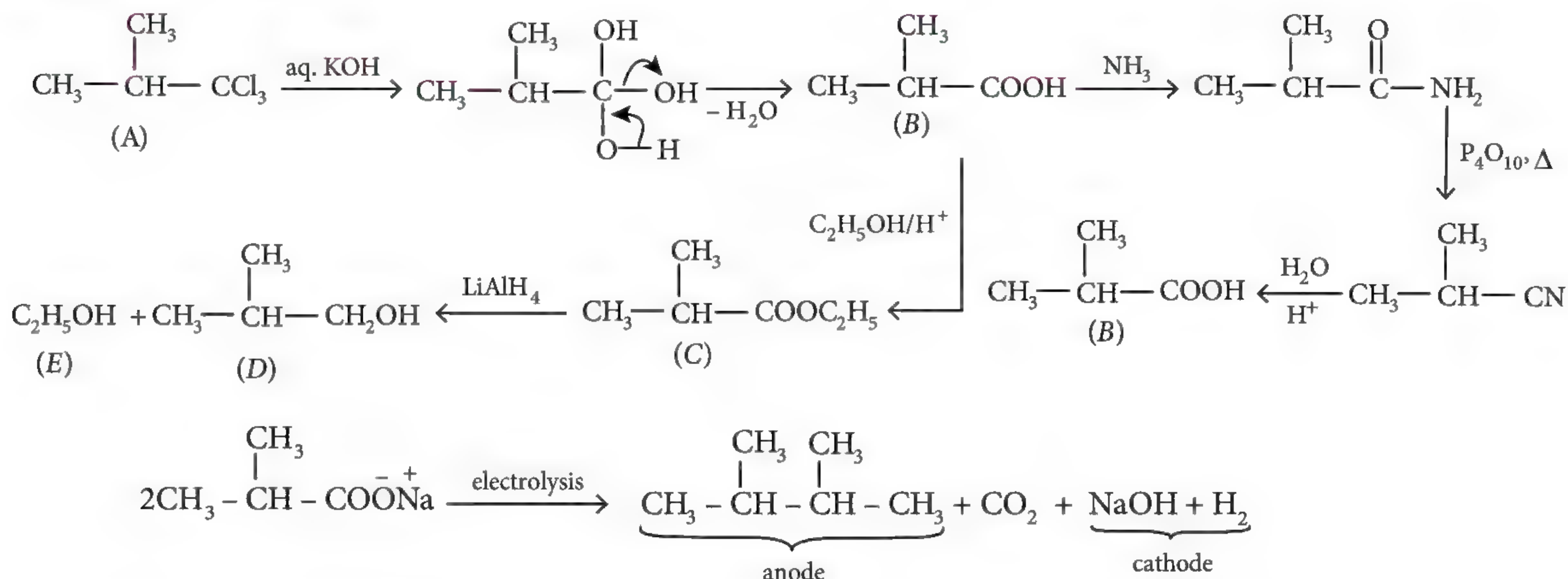
Thus, the metal M is potassium.

Hence, X is KO_2 , potassium superoxide

Y is K_2SO_4 , potassium sulphate

14. (a) : Z is $\text{K}_2\text{SO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}$; potash alum.

15. (c) 16. (b)



17. (3) : Let V_1 ml of NaNO_3 is mixed with V_2 ml of $\text{Ca}(\text{NO}_3)_2$.

millimoles of NaNO_3 mixed = $0.2 \times V_1$

millimoles of $\text{Ca}(\text{NO}_3)_2$ mixed = $0.1 \times V_2$

\therefore Molarity of NO_3^- in mixture = $[\text{NO}_3^-]$
(from NaNO_3) + 2NO_3^- (from $\text{Ca}(\text{NO}_3)_2$)

$$\frac{0.2 \times V_1}{(V_1 + V_2)} + \frac{0.1 \times 2 \times V_2}{(V_1 + V_2)}$$

[mole ratio of $\text{Ca}^{2+} : \text{NO}_3^-$ is 1 : 2]

$$\frac{0.2 \times V_1 + 0.2 \times V_2}{(V_1 + V_2)} \quad \dots(\text{i})$$

Molarity of Na^+ and Ca^{2+} ions in mixture.

$$\frac{0.2 \times V_1}{(V_1 + V_2)} + \frac{0.1 \times V_2}{(V_1 + V_2)} = \frac{0.2V_1 + 0.1V_2}{(V_1 + V_2)} \quad \dots(\text{ii})$$

Since the concentration of anions is 50% greater than that of cations,

$$\therefore \frac{0.2V_1 + 0.2V_2}{(V_1 + V_2)} = \frac{3}{2} \left[\frac{0.2V_1 + 0.1V_2}{(V_1 + V_2)} \right]$$

$$\therefore x = 1 \text{ and } y = 2$$

$$\text{So, } x + y = 3$$

18. (4) : Partial charge = $\frac{\text{Dipole moment}}{\text{Bond distance}}$

$$= \frac{1.20 \times 10^{-18}}{1.0 \times 10^{-8}} \text{ esu.cm} = 1.2 \times 10^{-10} \text{ esu}$$

$$\text{The fraction of an electronic charge} = \frac{1.2 \times 10^{-10}}{4.8 \times 10^{-10}} = \frac{1}{4}$$

Value of $x = 4$



Number of compounds = 3

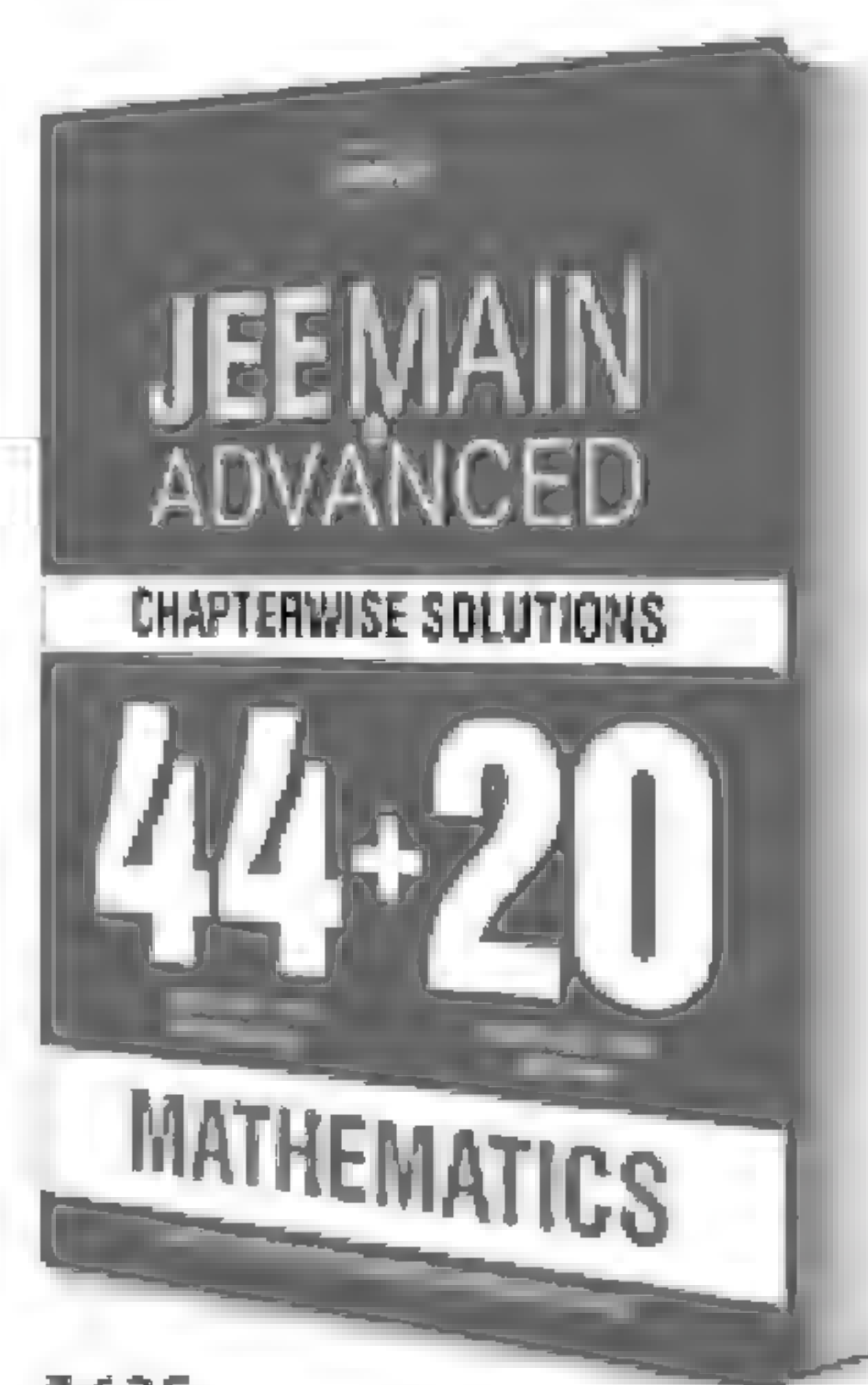
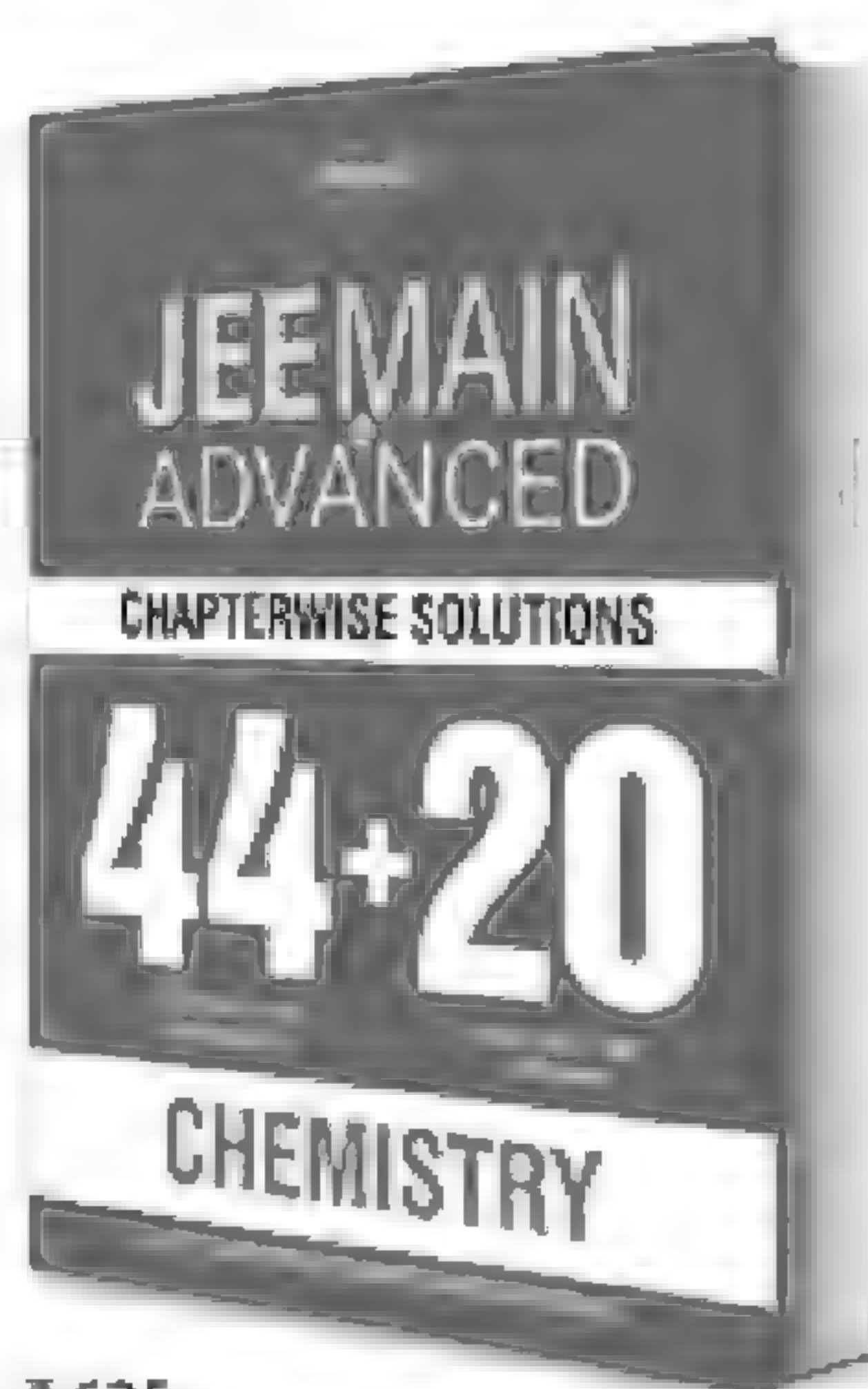
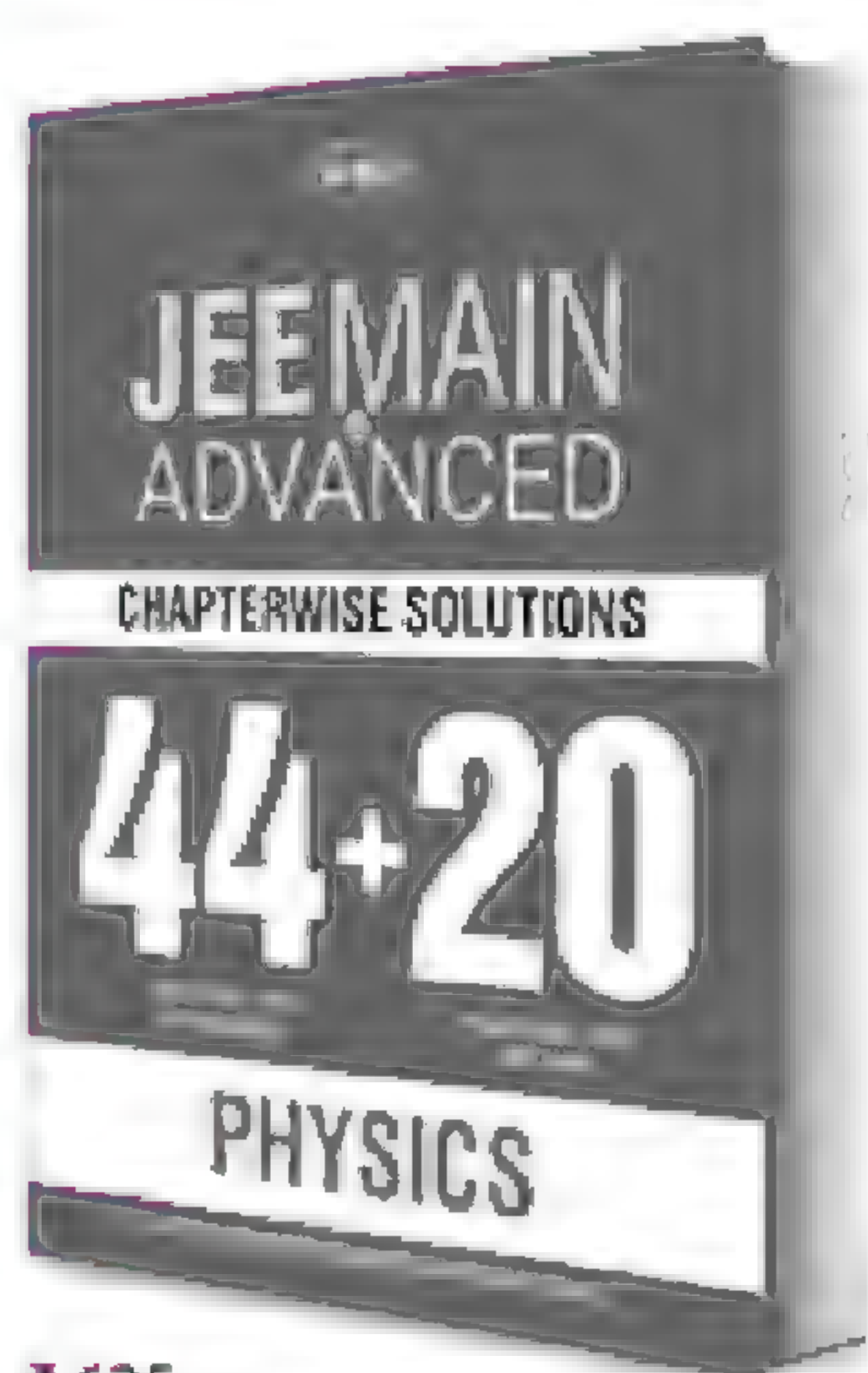
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Paragraph Type Questions

Paragraph for Q. No. 1 and 2

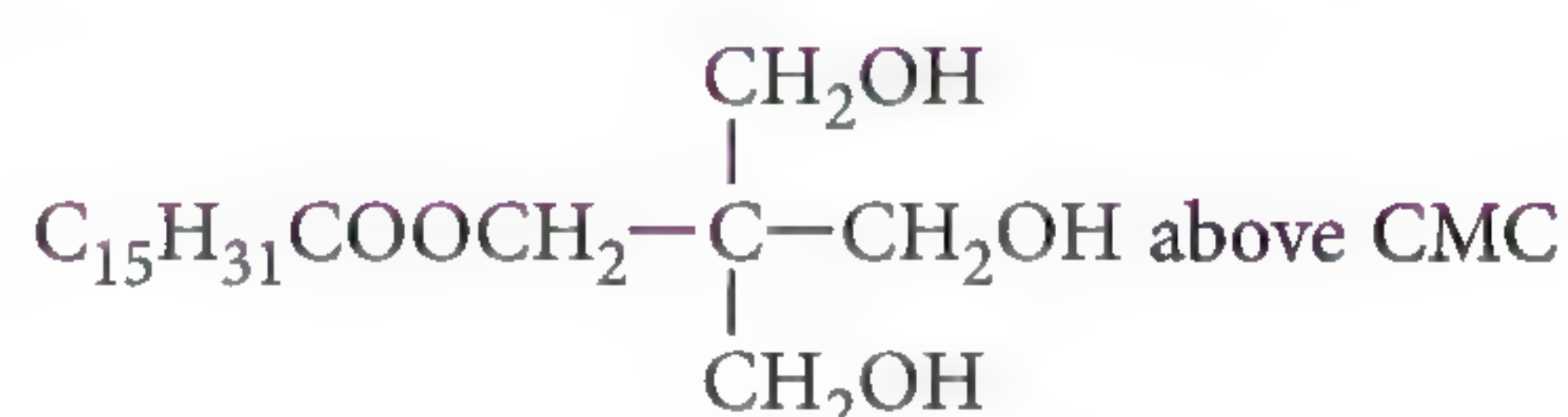
The atomic mass of an atom (element) is not its actual mass. It is relative mass as compared with an atom of carbon taken as 12. It is expressed in amu (u). The actual mass of an atom means its mass in grams which is obtained by dividing the atomic mass of the element by Avogadro's number (6.022×10^{23}) because one gram atom contains Avogadro's number of atoms.

- Which of the following has maximum mass?
 (a) 0.1 moles of ammonia
 (b) 1120 cc of carbon dioxide
 (c) 0.1 g atom of carbon
 (d) 6.022×10^{22} molecules of H_2 gas
- 5.6 L of a gas at NTP are found to have a mass of 11 g. The molecular mass of the gas is
 (a) 36 (b) 48 (c) 40 (d) 44

Paragraph for Q. No. 3 and 4

Measure of colligative properties of dilute solutions of many substances may be used to determine their molecular masses. However, in some cases the calculated values differ considerably from the normal values. Their departure from the normal values is owing to the change of molecular state of the solute in the solution. The ratio of normal molecular mass to the observed value called van't Hoff factor, i , reflects the kind of change of molecular state of the dissolved substance.

- Which of the following substances will not show the abnormal colligative properties in solutions?
 (a) Aqueous solution of sodium oleate
 (b) Aqueous solution of



- Phenol in benzene
 - Aqueous solution of thiourea
- Molal cryoscopic constant of water is $1.80 \text{ K kg mol}^{-1}$. A solution containing 6.00 g of pure acetic acid in 1 kg of water will show a depression of freezing point to be
 (a) 0.18 K
 (b) 0.36 K
 (c) slightly greater than 0.18 K
 (d) slightly less than 0.18 K

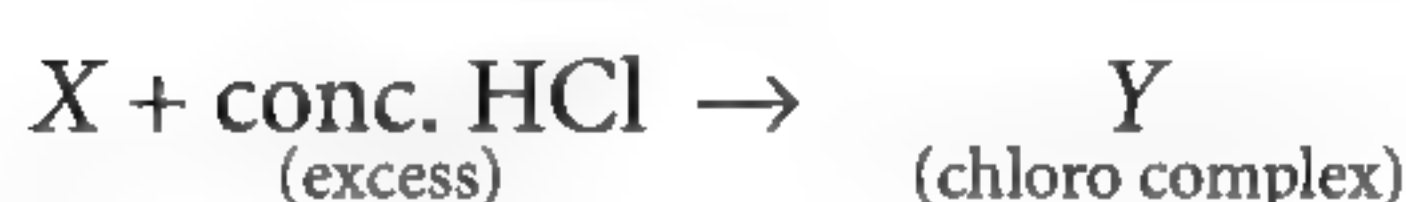
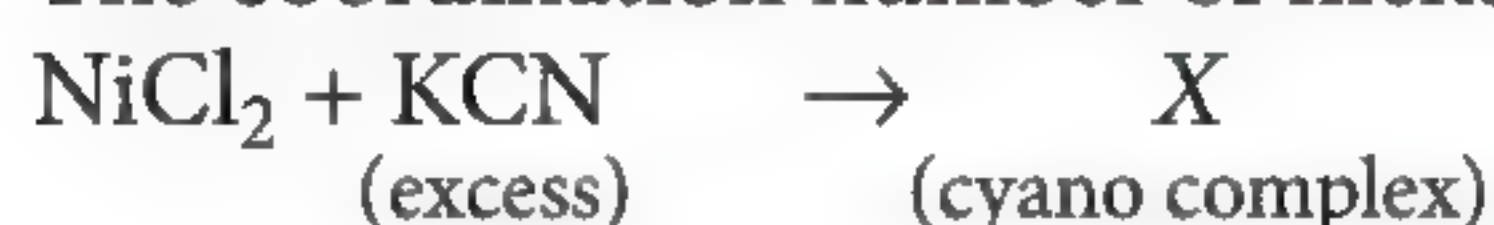
Paragraph for Q. No. 5 and 6

Although chlorobenzene is inert to nucleophilic substitution, it gives quantitative yield of phenol when heated with aq. NaOH at high temperature and high pressure. Phenol so formed is a weaker acid than the carboxylic acid hence, it dissolves only in strong bases like NaOH, but not in weak bases like $NaHCO_3$. It reacts with acid chlorides and acid anhydrides in the absence of $AlCl_3$ to form esters. As far as electrophilic substitution in phenol is concerned, the $-OH$ group is an activating group, hence, its presence enhances the electrophilic substitution at o - and p -positions. Condensation with formaldehyde is one of the important property of phenol. The condensation may takes place in presence of acids or alkalis and leads to the formation of bakelite, an important industrial polymer.

5. Conversion of chlorobenzene into phenol involves
 (a) modified S_N1 mechanism
 (b) modified S_N2 mechanism
 (c) both (a) and (b)
 (d) elimination - addition mechanism.
6. Phenol undergoes electrophilic substitution more readily than benzene because
 (a) the intermediate carbocation is a resonance hybrid of more resonating structures than that from benzene.
 (b) the intermediate is more stable as it has positive charge on oxygen, which can be better accommodated than on carbon.
 (c) in one of the canonical structures, every atom (except hydrogen) has complete octet
 (d) the $-\text{OH}$ group is *o*, *p*-directing which like all other *o*, *p*-directing groups is activating.

Paragraph for Q. No. 7 and 8

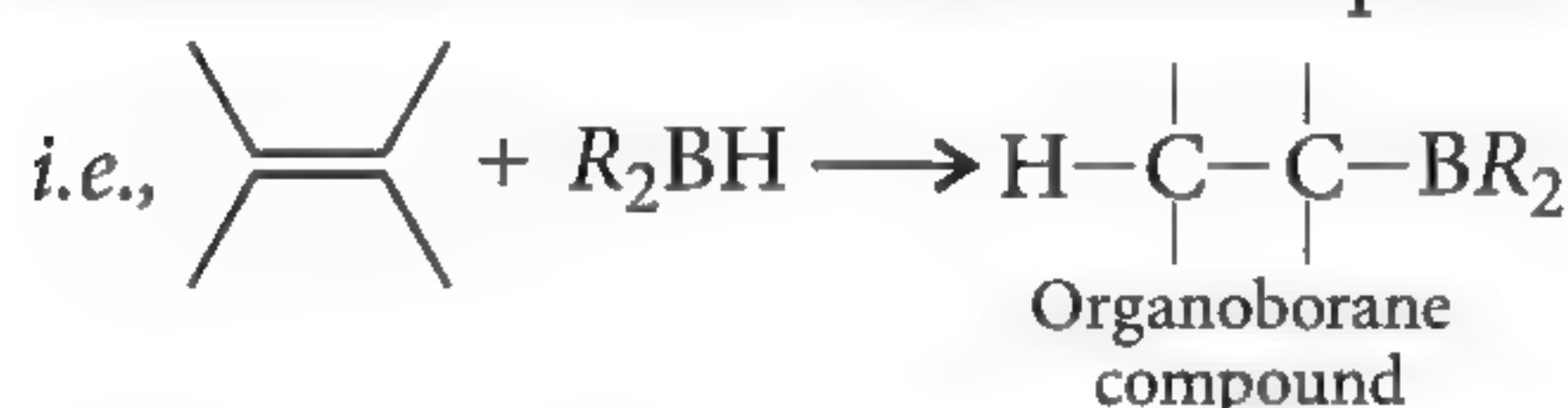
The coordination number of nickel (II) ion is 4.



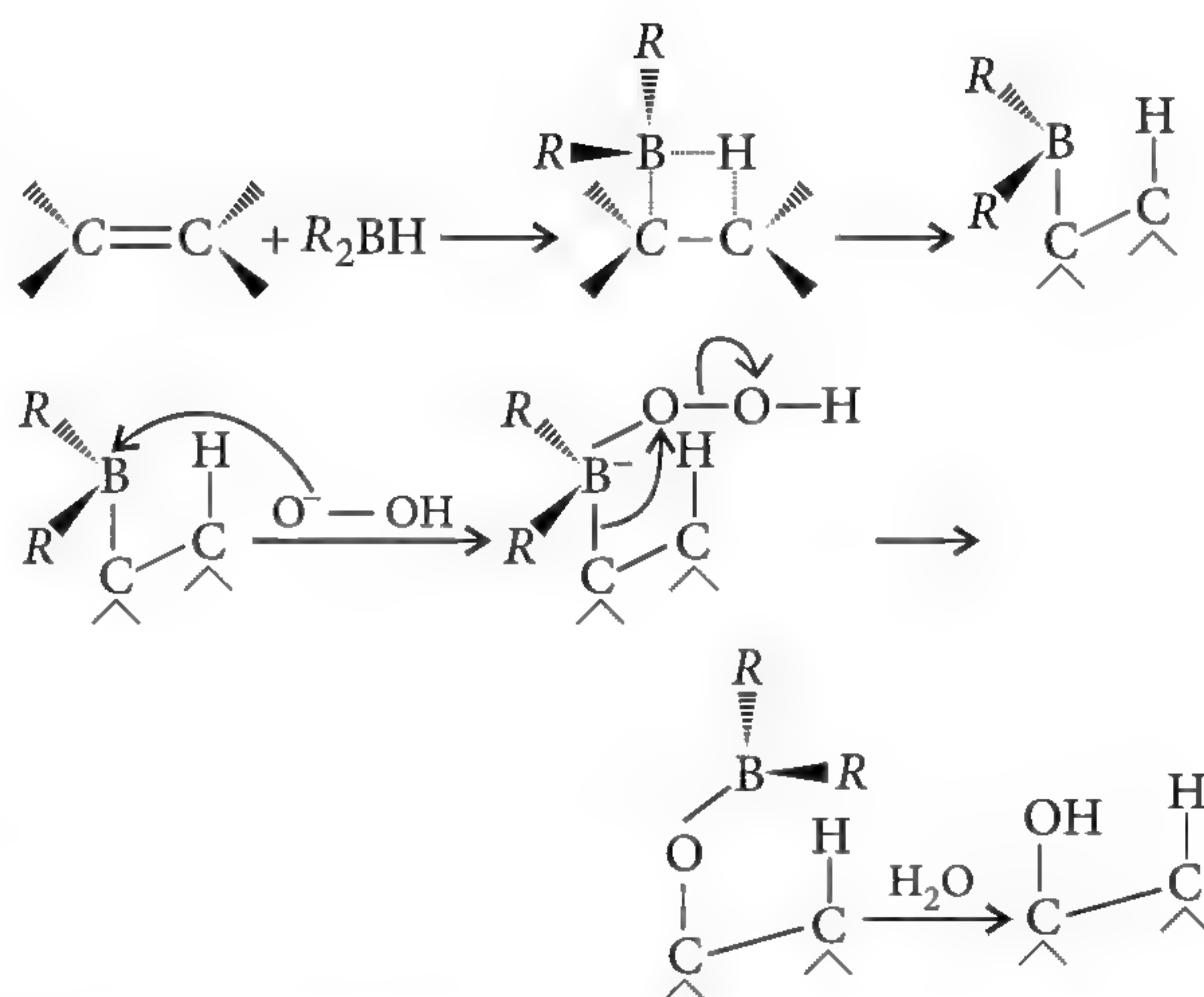
7. The IUPAC names for the complexes X and Y are respectively,
 (a) potassium tetracyanonickel(II), potassium tetrachloronickel(II).
 (b) tetracyanonickel(II), tetrachloronickel(II).
 (c) tetracyanopotassium nickelate(II), tetra chloro potassium nickelate(III).
 (d) potassium tetracyanonickelate(II), potassium tetrachloronickelate (II).
8. The hybridisation of X and Y are
 (a) sp^3d^2 , dsp^2 (b) dsp^2 , sp^3
 (c) sp^3 , sp^3 (d) sp^3 , dsp^3

Paragraph for Q. No. 9 and 10

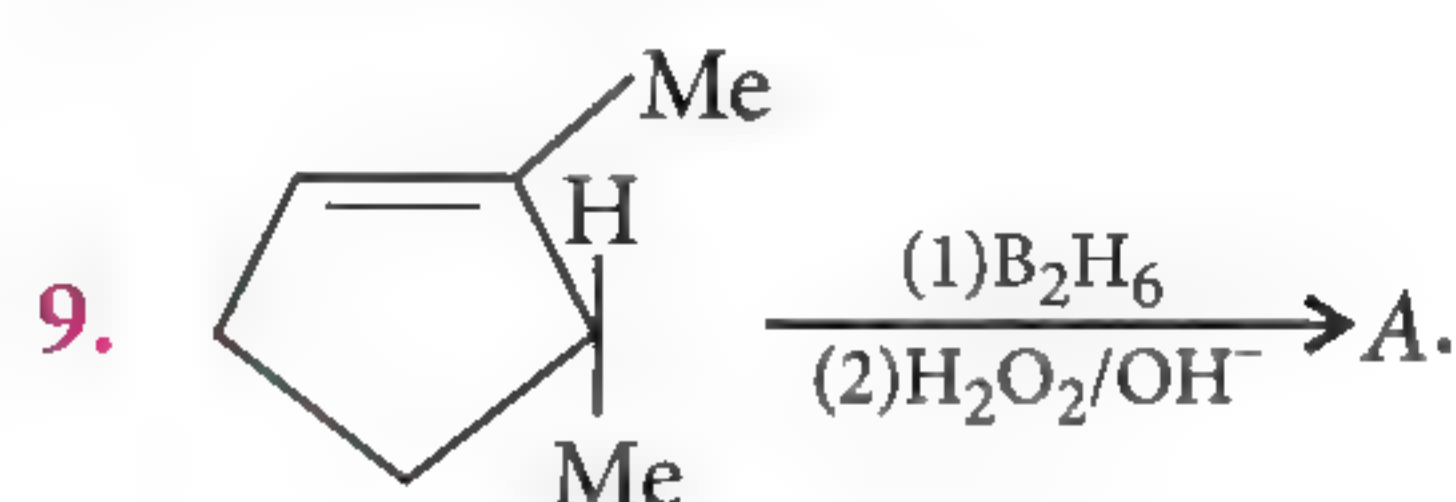
Hydroboration is a reaction in which the boron hydride acts as an electrophile. $R_2\text{BH}$ adds to a carbon-carbon double bond which acts as a nucleophile



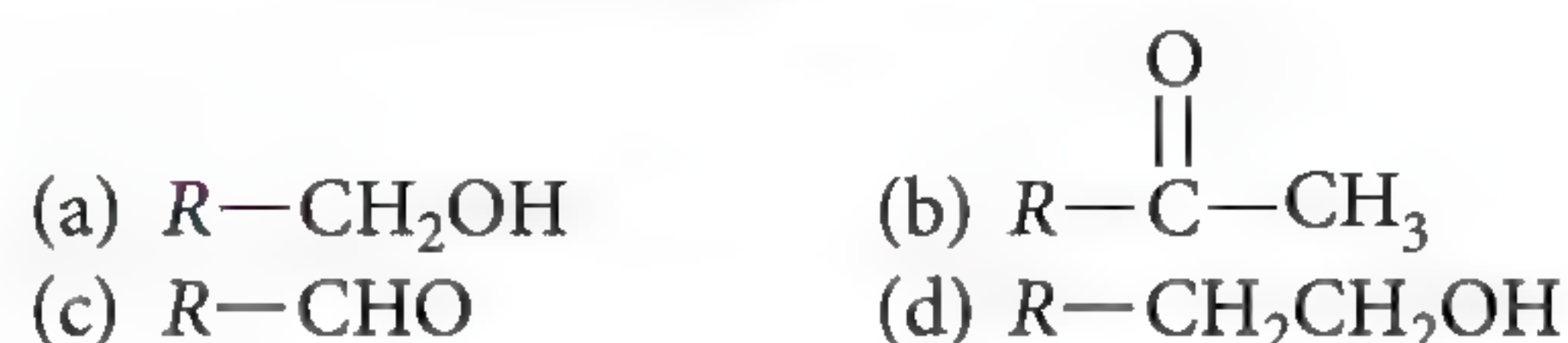
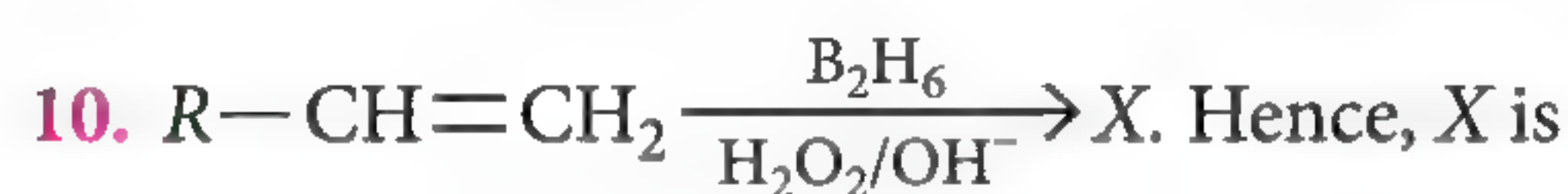
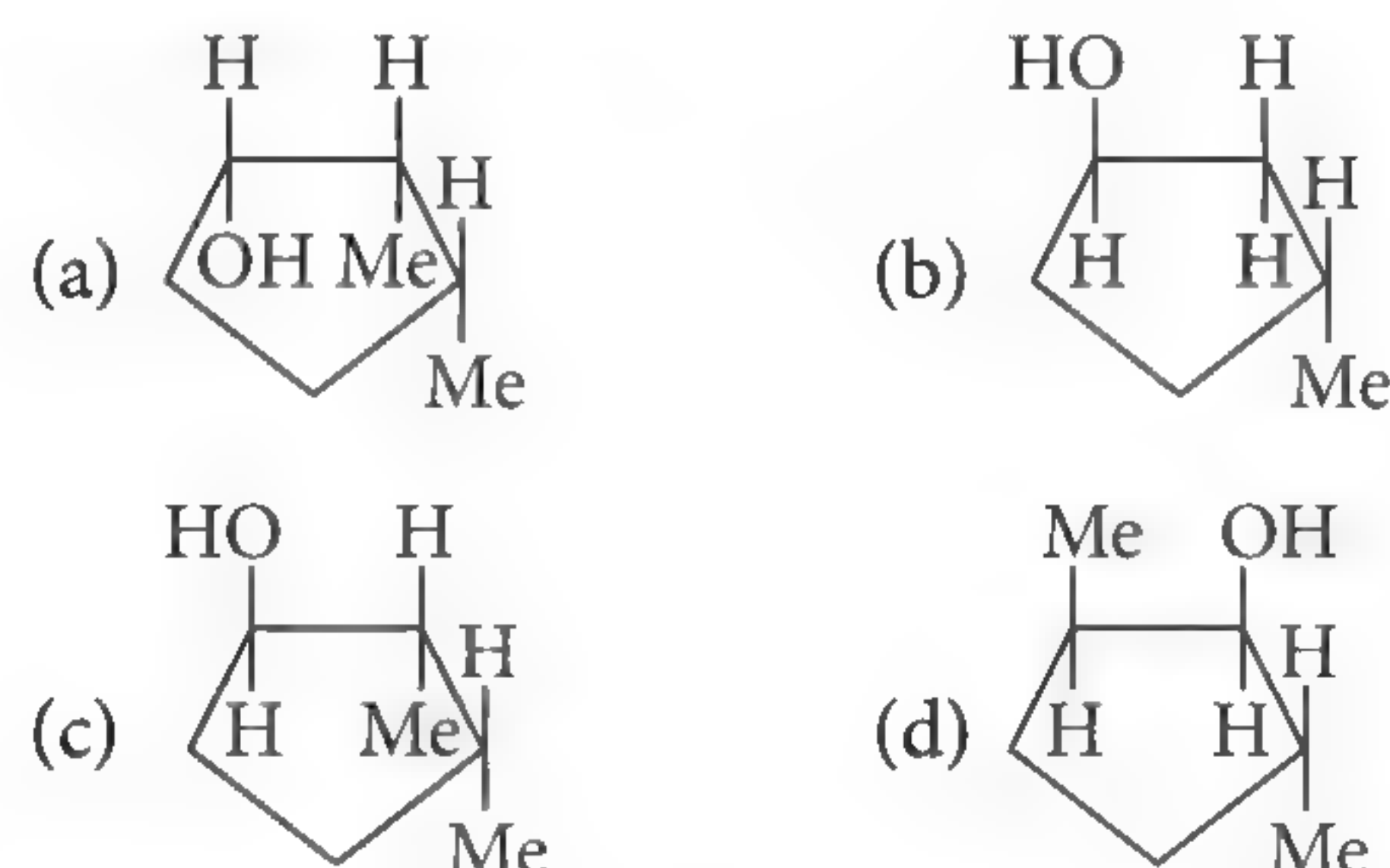
The organoborane compound is then oxidised by treatment with hydrogen peroxide in aqueous medium to form alcohol. The $-\text{OH}$ group enters the carbon atom from the same side where the boron atom was present.



Hence, this reaction is highly regioselective and the boron atom attaches to that carbon atom which is less sterically hindered.



Hence, compound A is



Matching List Type

11. The values of IE_1 and IE_2 (kJ mol^{-1}) of few elements are given in List I. Match their characteristics given in List II.

List I		List II	
P.	IE_1-2372, IE_2-5251	1.	A reactive metal
Q.	IE_1-520, IE_2-7300	2.	A reactive non-metal
R.	IE_1-900, IE_2-1760	3.	A noble gas
S.	IE_1-1680, IE_2-3380	4.	A metal that forms an halide of formula AX_2

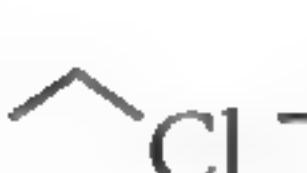
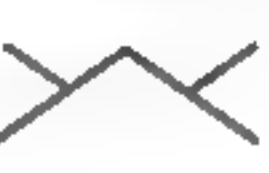






	P	Q	R	S
(a)	3	4	2	1
(b)	3	1	4	2
(c)	1	2	3	4
(d)	4	3	2	1

12. Match the List I with List II and select the correct answer using the code given below the lists :

	List I	List II
P.	Diethyl ether, methyl isopropyl ether	1. Tautomers
Q.	Acetaldehyde, vinyl alcohol	2. Chain isomers
R.	<i>sec</i> -Butyl alcohol and <i>tert</i> -butyl alcohol	3. Functional isomers
S.	Methyl cyanide, methyl isonitrile	4. Metamers

	P	Q	R	S
(a)	1	2	3	4
(b)	4	3	1	2
(c)	4	1	2	3
(d)	3	4	1	2

13. Match the entries of List I with appropriate entries of List II and select the correct answer using the code given below the lists :

	List I	List II
P.	 $\xrightarrow[\text{CuI}]{\text{Li}}$ $\xrightarrow{\text{CH}_3\text{CH}_2\text{Cl}}$	1. 
Q.	 $\xrightarrow[\text{CuI}]{\text{Li}}$ $\xrightarrow{\text{Br}}$	2. 
R.	 $\xrightarrow[\text{CuI}]{\text{Li}}$ $\xrightarrow{\text{CH}_3\text{CH}_2\text{Br}}$	3. 
S.	 $\xrightarrow[\text{CuI}]{\text{Li}}$ $\xrightarrow{\text{CH}_3\text{CH}_2\text{Br}}$	4. 

	P	Q	R	S
(a)	1	2	3	4
(b)	4	3	1	2
(c)	3	4	2	1
(d)	2	1	4	3

14. Match the List I with List II and select the correct answer using the codes given below the lists :

	List I	List II
P.	XeF_4	1. sp^3d , see-saw
Q.	SF_4	2. sp^3d^2 , square planar
R.	SF_6	3. sp^3d^3 , distorted octahedral
S.	XeF_6	4. sp^3d^2 , octahedral

	P	Q	R	S
(a)	4	1	2	3
(b)	2	1	4	3
(c)	2	1	3	4
(d)	1	2	4	3

15. Match the gases under specified conditions listed in Column I with their properties/laws in Column II :

	List I	List II
A.	Hydrogen gas ($P = 200$ atm, $T = 273$ K)	p. Compressibility factor $\neq 1$
B.	Hydrogen gas ($P \approx 0$, $T = 273$ K)	q. Attractive forces are dominant
C.	CO_2 ($P = 1$ atm, $T = 273$ K)	r. $PV = nRT$
D.	Real gas with very large molar volume	s. $P(V - nb) = nRT$

	P	Q	R	S
(a)	p,s	r	q	r
(b)	p,r	q	s	p
(c)	r	p,s	q	s
(d)	p,q	r	s	p

16. Match the cells/cell reactions in List I with their values in List II and select the correct answer using the code given below in the lists :

	List I	List II
P.	Oxidation potential of hydrogen electrode set up in a solution with $\text{pH} = 2$	1. 0.018 V
Q.	Oxidation potential of hydrogen electrode set up in 0.5 M HCl solution	2. 0.059 V
R.	EMF of concentration cell with hydrogen electrodes set up in 0.1 M and 0.01 M HCl solutions	3. 0.035 V
S.	EMF of concentration cell with hydrogen electrodes set up in 0.1 M and 0.4 M HCl solutions	4. 0.118 V

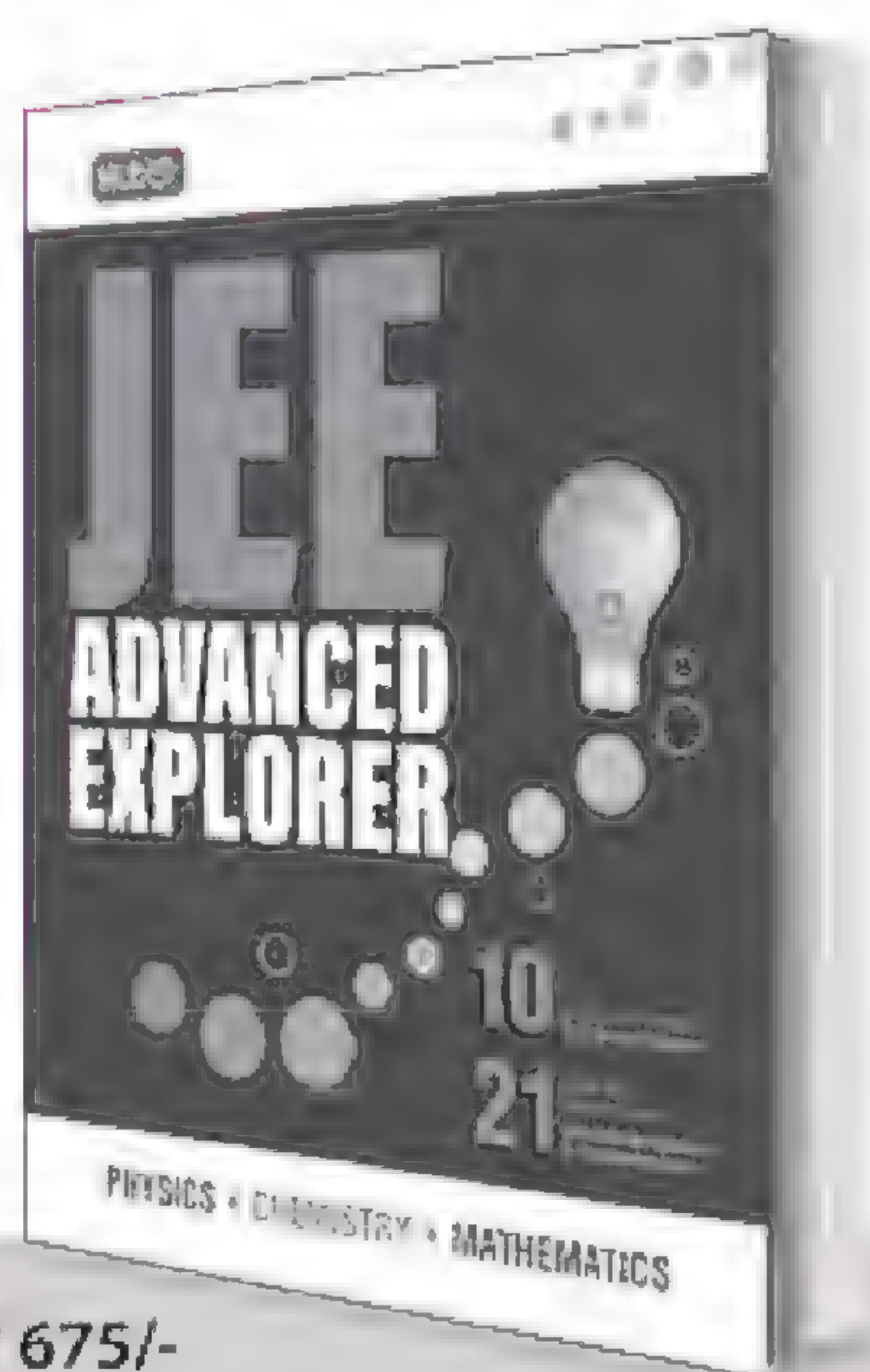
	P	Q	R	S
(a)	2	1	3	4
(b)	4	1	2	3
(c)	1	2	4	3
(d)	4	2	1	3



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17. Match the List I with List II and select the correct answer using the codes given below the lists :

List I		List II	
(P) Borazine		1. Na_2SiO_3	
(Q) Phosgene		2. Bead with copper salts	
(R) Water glass		3. COCl_2	
(S) Borax		4. $\text{B}_3\text{N}_3\text{H}_6$	
P	Q	R	S
(a) 4	1	2	3
(b) 3	4	2	1
(c) 1	2	3	4
(d) 4	3	1	2

18. Match the entries of List I with appropriate entries of List II and select the correct answer using the code given below the lists :

List I		List II	
1. Cr		(p) $5d^{10} 6s^1$	
2. Au		(q) $3d^5 4s^1$	
3. Pd		(r) $4f^7 5d^1 6s^2$	
4. Gd		(s) $4d^{10} 5s^0$	
1	2	3	4
(a) q	p	s	r
(b) p	s	q	r
(c) s	q	r	p
(d) r	s	p	q

19. Match the entries of List I with appropriate entries of List II and select the correct answer using the codes given below the lists :

List I		List II	
P. Glycosidic linkage		1. Globular protein	
Q. Maltase		2. Connects two monosaccharide units	
R. Peptide bond		3. Monomeric unit of nucleic acids	
S. Nucleotide		4. Connects two amino acid units	
P	Q	R	S
(a) 4	3	2	1
(b) 3	4	1	2
(c) 2	1	4	3
(d) 1	2	3	4

20. Match List-I with List-II.

List-I (Species)	List-II (Hybrid Orbitals)
(A) SF_4	(i) $sp^3 d^2$
(B) IF_5	(ii) $d^2 sp^3$
(C) NO_2^+	(iii) $sp^3 d$
(D) NH_4^+	(iv) sp^3
	(v) sp

Choose the correct answer from the options given below.

- (a) (A) – (iii), (B) – (i), (C) – (v) and (D) – (iv)
 (b) (A) – (ii), (B) – (i), (C) – (iv) and (D) – (v)
 (c) (A) – (iv), (B) – (iii), (C) – (ii) and (D) – (v)
 (d) (A) – (i), (B) – (ii), (C) – (v) and (D) – (iii)

Integer Answer Type

21. The mole fraction of a solute in a solution is 0.1. At 298 K, molarity of this solution is the same as its molality. Density of this solution at 298 K is 2.0 kg cm^{-3} . The ratio of the molecular weights of the solute and solvent, $\left(\frac{MW_{\text{solute}}}{MW_{\text{solvent}}} \right)$, is _____.
22. Two moles of MnO_4^- reduce x mole(s) of H_2O_2 in basic medium. The value of x is _____.
23. The number of P—O—P bonds in P_4O_{10} is _____.
24. The rate constant of a zero order reaction is $3 \times 10^{-3} \text{ mol L}^{-1} \text{ s}^{-1}$. The time taken in seconds for the initial concentration of reactant to fall from 0.10 M to 0.076 M will be _____.
25. One mole of lithium nitride is decomposed by H_2O and resultant solution is neutralised by HCl. Number of moles of HCl required is _____.
26. How many of the following amines are more basic than aniline?
o-toluidine, *m*-toluidine, *p*-toluidine, *p*-anisidine, *m*-anisidine, *o*-anisidine, *p*-aminophenol, *m*-aminophenol, *o*-aminophenol.
27. Ionisation constant of formic acid is 2×10^{-4} at 198 K. The H_3O^+ ion concentration in 0.01 M solution of formic acid at equilibrium is $1.4 \times 10^{-x} \text{ mol L}^{-1}$. The value of x is _____.
28. A compound $\text{A}(\text{C}_5\text{H}_8\text{O}_2)$ is reduced to pentane with Zn-Hg/HCl. It forms a dioxime with NH_2OH and also gives positive iodoform and Tollens' tests. The number of ketonic groups present in A is _____.
29. In an adsorption experiment, a graph between $\log (x/m)$ versus $\log p$ was found to be linear with a slope of 45° and the intercept was 0.3010. The amount of the gas adsorbed per gram of charcoal under a pressure of 0.5 atm will be _____.
30. Entropy of X_2 , Y_2 and XY_3 are 60, 40 and $50 \text{ JK}^{-1} \text{ mol}^{-1}$ respectively. For the reaction, $1/2 \text{X}_2 + 3/2 \text{Y}_2 \longrightarrow \text{XY}_3$, $\Delta H = -30 \text{ kJ}$, to be at equilibrium, the temperature is $(x^2 + 145x) \text{ K}$. The value of x is _____.

SOLUTIONS

1. (b): 0.1 g-atom of C = 1.2 g

$$0.1 \text{ mol of } \text{NH}_3 = 1.7 \text{ g}$$
$$6.022 \times 10^{23} \text{ molecules of H}_2 = 2 \text{ g}$$

$$6.022 \times 10^{22} \text{ molecules of H}_2 = \frac{2 \times 6.022 \times 10^{22}}{6.022 \times 10^{23}} = 0.2 \text{ g}$$

$$1120 \text{ cc of CO}_2 = \frac{44}{22400} \times 1120 = 2.2 \text{ g}$$

2. (d): 5.6 L of a gas at NTP have mass = 11 g

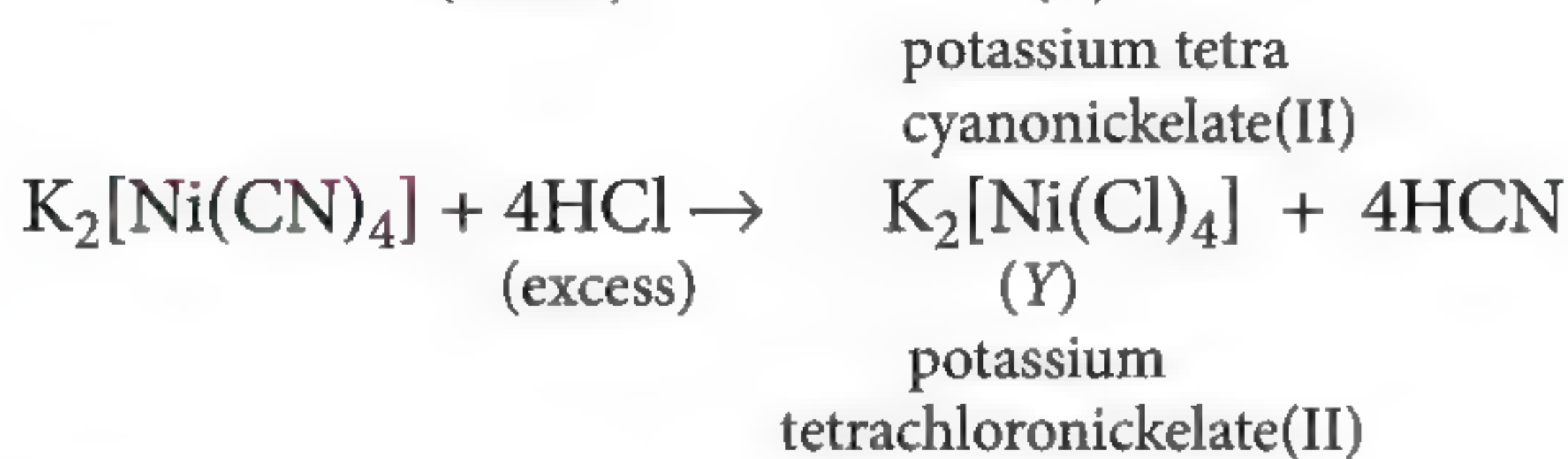
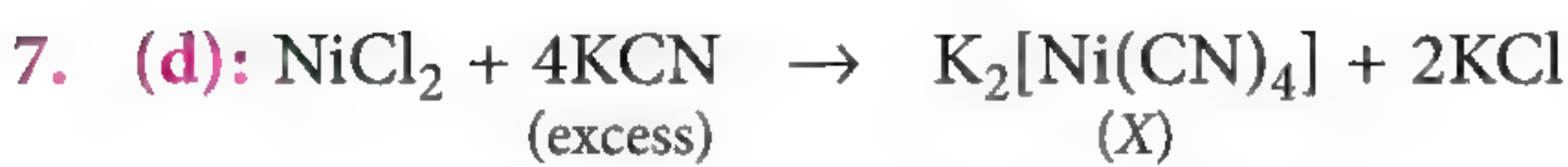
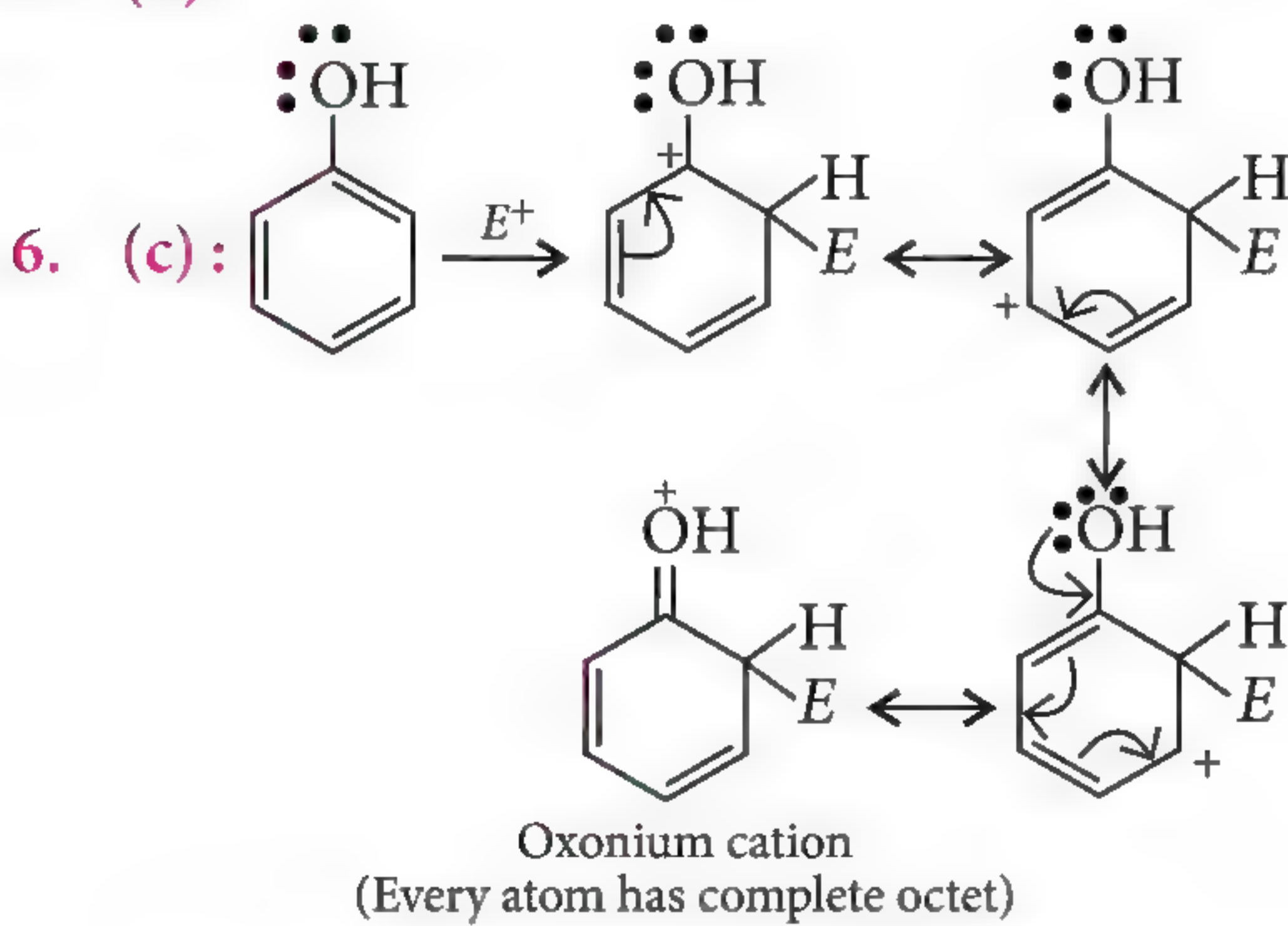
$$\therefore 22.4 \text{ L of gas at NTP have mass} = \frac{11}{5.6} \times 22.4 = 44 \text{ g}$$

3. (d): In (a) and (b), the solutes undergo micellization in solution and in (c) the solute undergoes dimerisation. As a result, the observed colligative properties will be lower than the normal values.

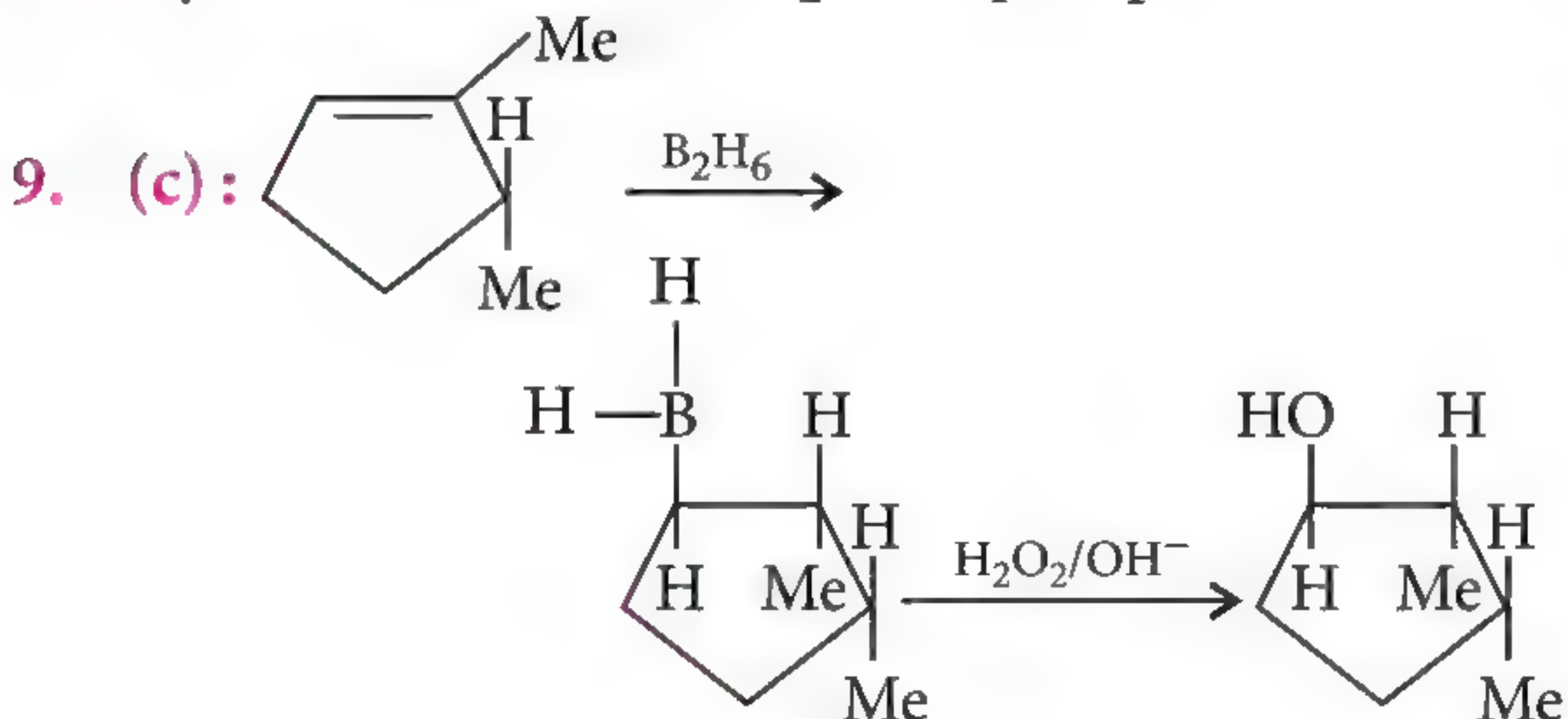
4. (c): Normal value of $\Delta T_f = K_f m = 1.80 \times \frac{6}{60} = 0.18 \text{ K}$

Acetic acid is a uni-univalent weak electrolyte and ionises feebly, hence ' i ' is slightly greater than unity.

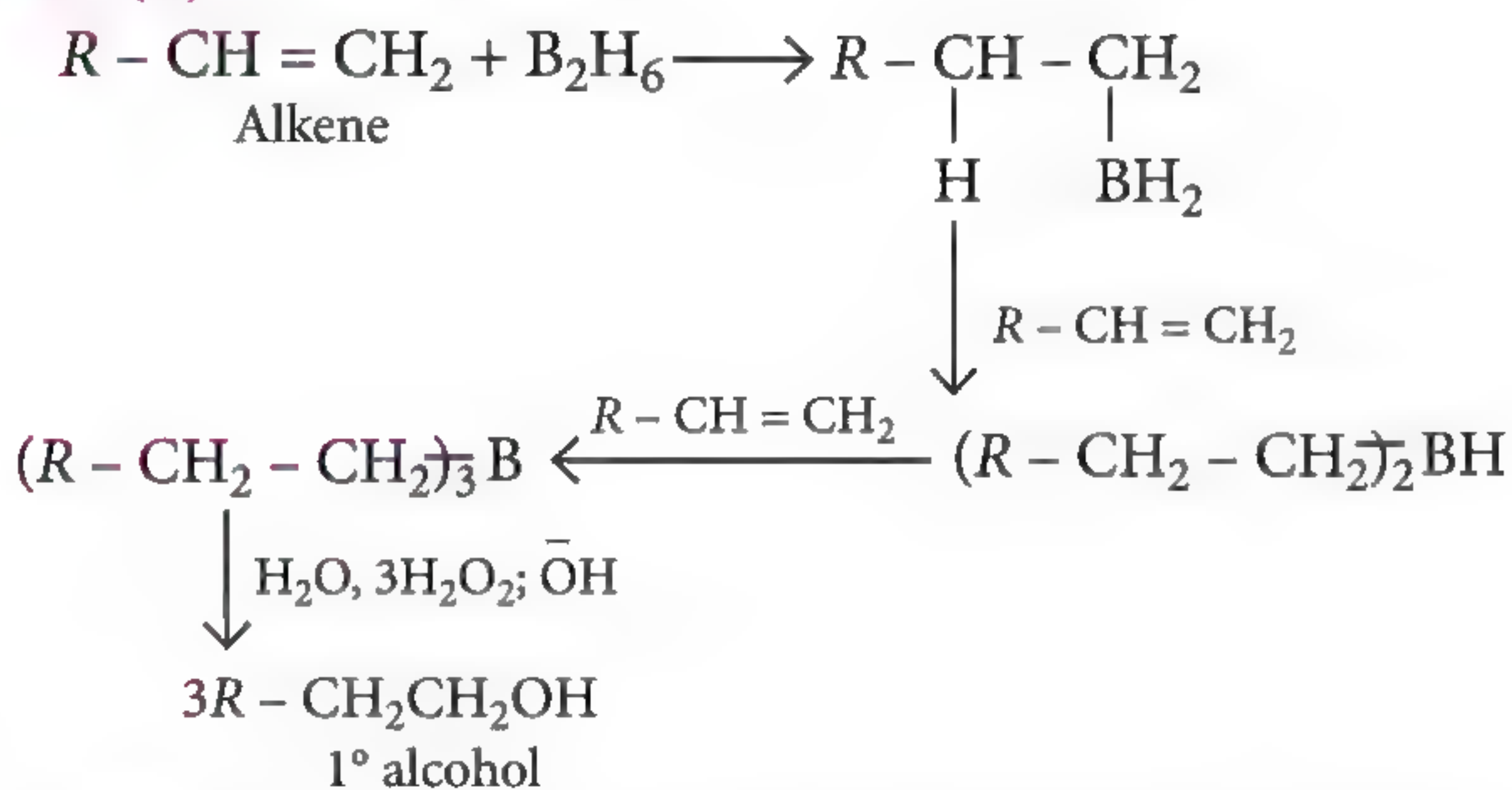
5. (d)



8. (b): Hybridisation of $X \rightarrow K_2[Ni(CN)_4]$ is dsp^2 .
Hybridisation of $Y \rightarrow K_2[NiCl_4]$ is sp^3 .



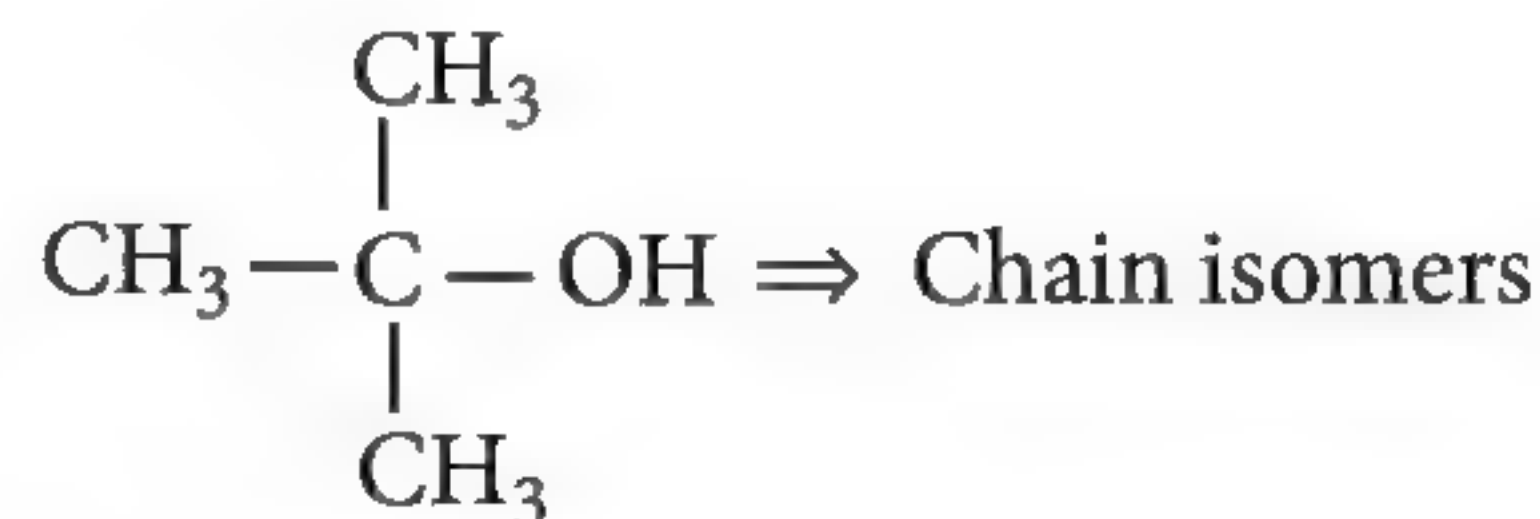
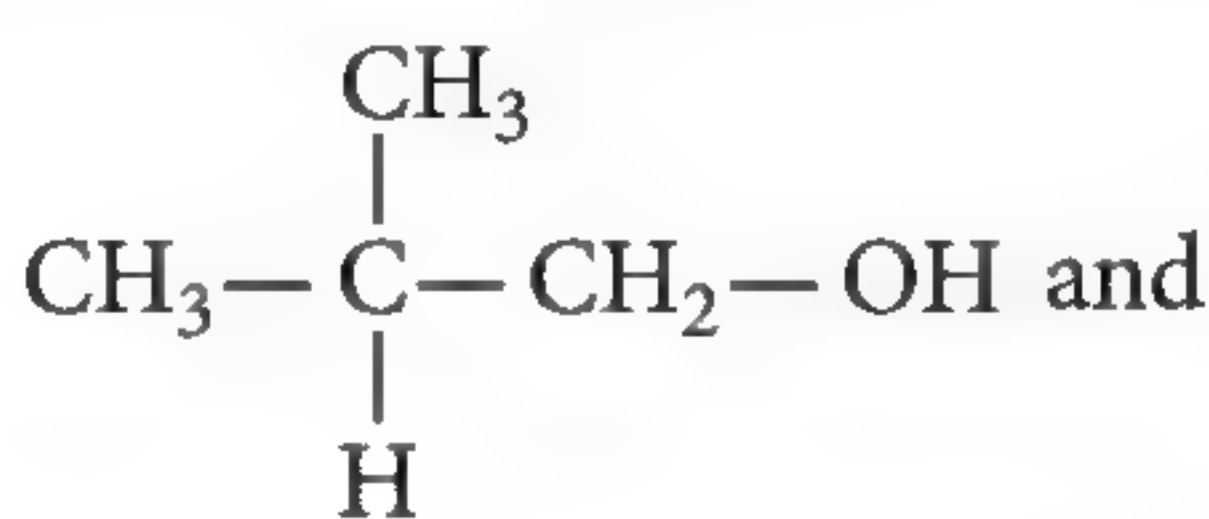
10. (d):



11. (b): Ionisation energy for noble gases is maximum
hence, $P \rightarrow 3$

- First ionisation energy for a reactive metal is lowest. But second ionisation energy is high as electron is removed from stable M^+ ion. So, $Q \rightarrow 1$.
 $R \rightarrow (4)$.
- Ionisation energy of non-metals is higher than metals because non-metals have the tendency to gain electrons. So, $S \rightarrow (2)$.

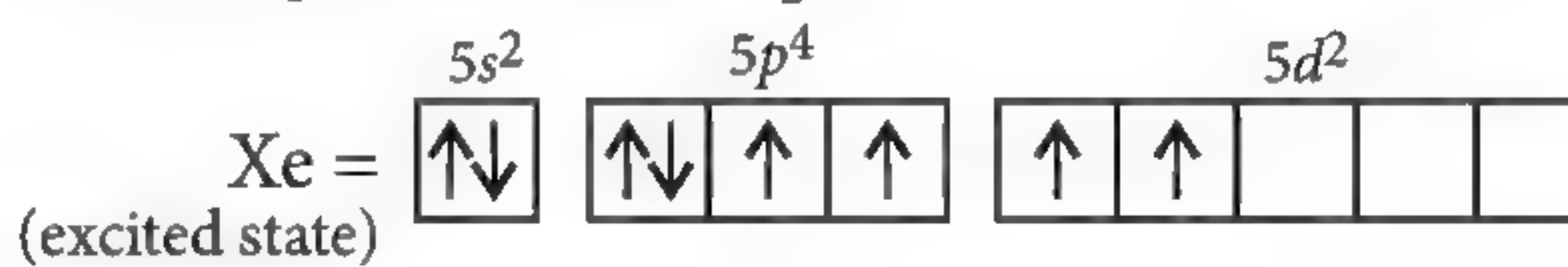
12. (c): $\text{H}_5\text{C}_2 - \text{O} - \text{C}_2\text{H}_5$ and $\begin{array}{c} \text{H}_3\text{C} \\ \diagdown \\ \text{C} - \text{O} - \text{CH}_3 \\ \diagup \\ \text{H}_3\text{C} \end{array}$
 \Rightarrow Metamers

$$\text{CH}_3\text{CHO and H}_2\text{C}=\text{CH}-\text{OH} \Rightarrow \text{Tautomers}$$

$$\text{CH}_3 - \text{CN} \text{ and } \text{CH}_3 - \text{NC} \Rightarrow \text{Functional isomers}$$

13. (d)

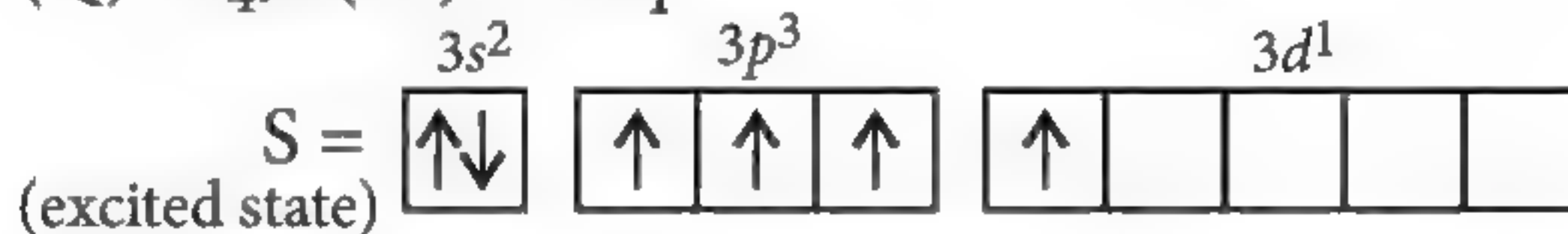
14. (b): P-(2); Q-(1); R-(4); S-(3)

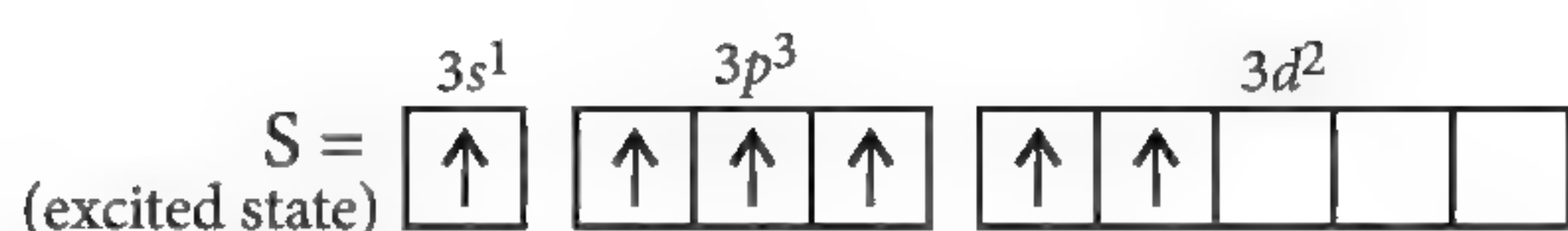
(P) XeF_4 , $\text{Xe}(54) : 5s^2, 5p^6$



sp^3d^2 hybridisation, two lone pairs of electrons occupy two vertices of octahedron while 4 vertices are occupied by 4 F-atoms hence, square planar geometry.

(Q) SF_4 , S(16) : $3s^2 3p^4$

 sp^3d hybridisation – square pyramidal or see-saw (R) $\text{SF}_6, \text{S}(16) :$



sp^3d^2 hybridisation – octahedral geometry

(S) XeF_6 , Xe(54) :



sp^3d^3 hybridisation-distorted octahedral geometry

The hybrid orbitals will be directed towards 7 vertices of pentagonal bipyramid. Since one of the vertex is occupied by a lone pair, actual geometry is distorted octahedral.

15. (a) : (A) $\rightarrow p$, s, (B) $\rightarrow r$, (C) $\rightarrow q$, (D) $\rightarrow r$

(A) For H_2 gas, the value of 'a' is negligible.

$$\therefore P(V - nb) = nRT \quad \text{or,} \quad \frac{PV}{nRT} = Z = 1 + \frac{Pb}{RT}$$

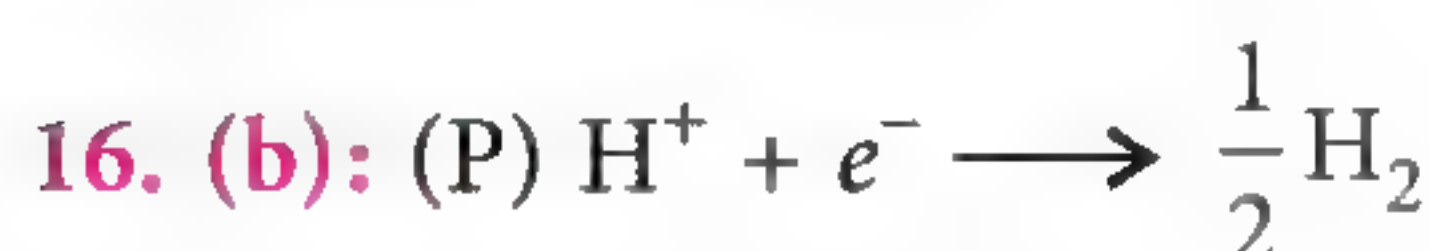
Therefore, compressibility factor of H_2 is always greater than 1.

(B) At extremely low pressure, real gas (H_2) behaves almost ideally, hence for H_2 gas at 0 atm, $PV = nRT$.

(C) CO_2 at room temperature, behaves ideally and van der Waals' force of attraction dominates.

$$(D) \left(P + \frac{an^2}{V^2} \right) (V - nb) = nRT$$

If V is very high, $PV = nRT$.



$$E_{\text{H}^+/\frac{1}{2}\text{H}_2} = E^\circ - \frac{0.059}{1} \log \frac{1}{[\text{H}^+]} \\ = 0 - 0.059 \text{ pH} = -0.059 \times 2 = -0.118 \text{ V}$$

\therefore Oxidation potential = 0.118 V

P \rightarrow 4

$$(Q) E_{\text{H}^+/\frac{1}{2}\text{H}_2} = -\frac{0.059}{1} \log \frac{1}{0.5} \\ = -0.059 \log 2 = -0.018 \text{ V}$$

\therefore Oxidation potential = 0.018 V

Q \rightarrow 1

$$(R) E_{\text{cell}} = \frac{0.059}{2} \log \frac{C_2}{C_1}$$

$$\Rightarrow E_{\text{cell}} = \frac{0.059}{2} \log \frac{0.1}{0.01} = 0.059 \text{ V}$$

R \rightarrow 2

$$(S) E_{\text{cell}} = \frac{0.059}{1} \log \frac{0.4}{0.1} = 0.0591 \log 4 = 0.035 \text{ V}$$

S \rightarrow 3

17. (d) : (P) \rightarrow 4; Borazine is $\text{B}_3\text{N}_3\text{H}_6$

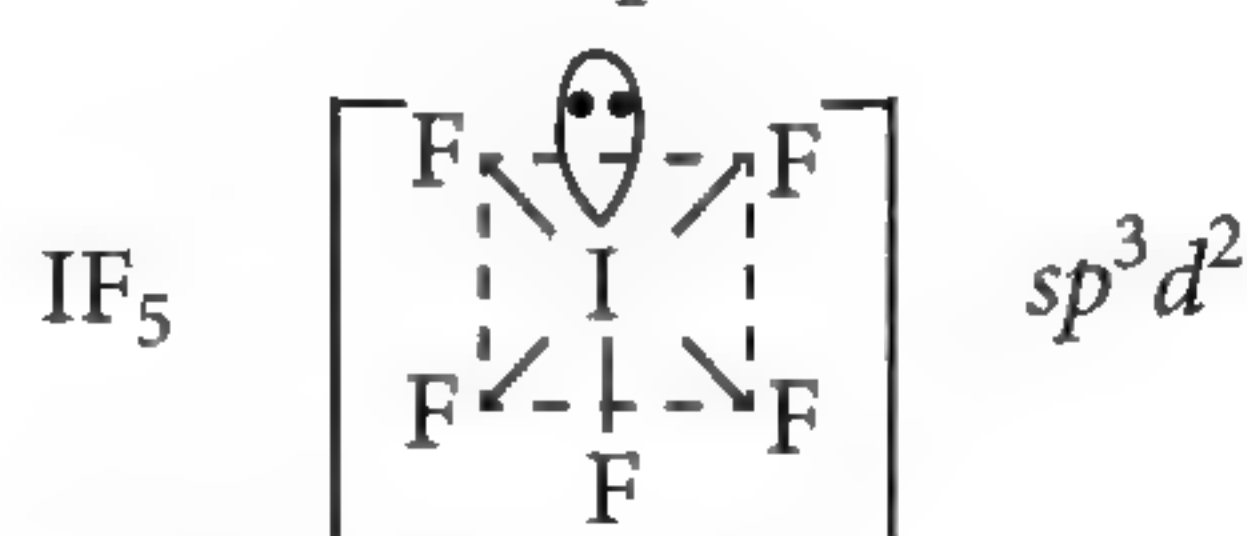
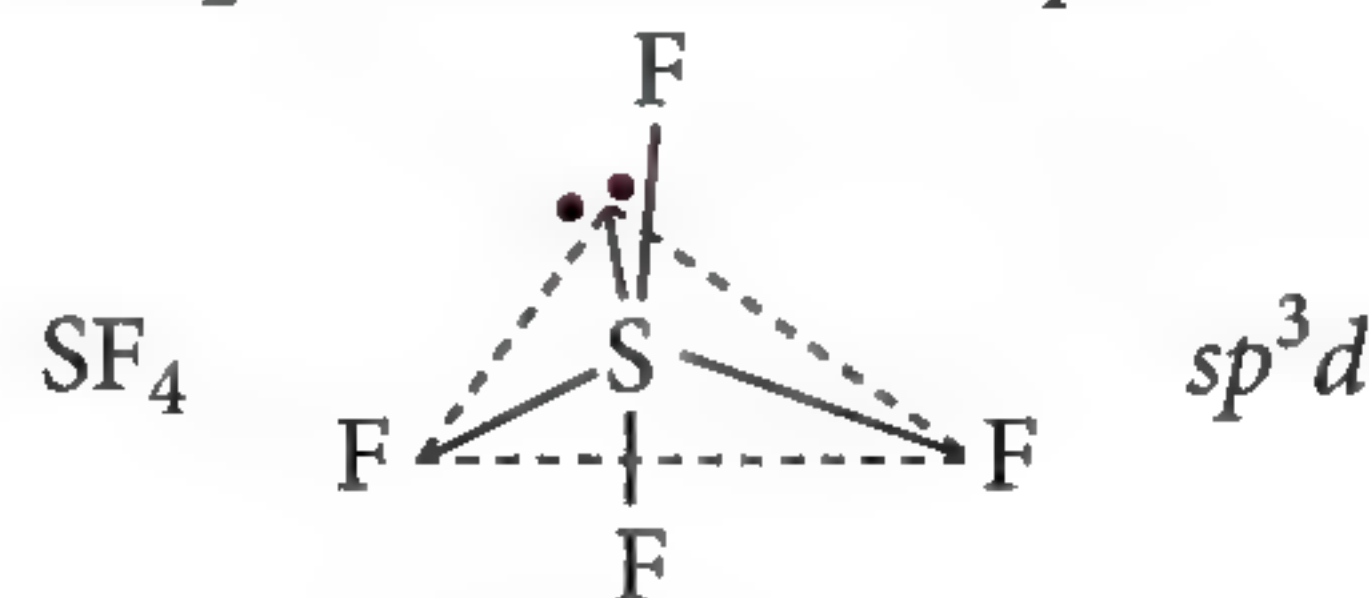
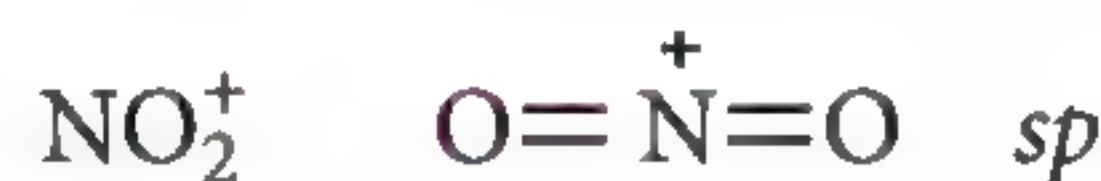
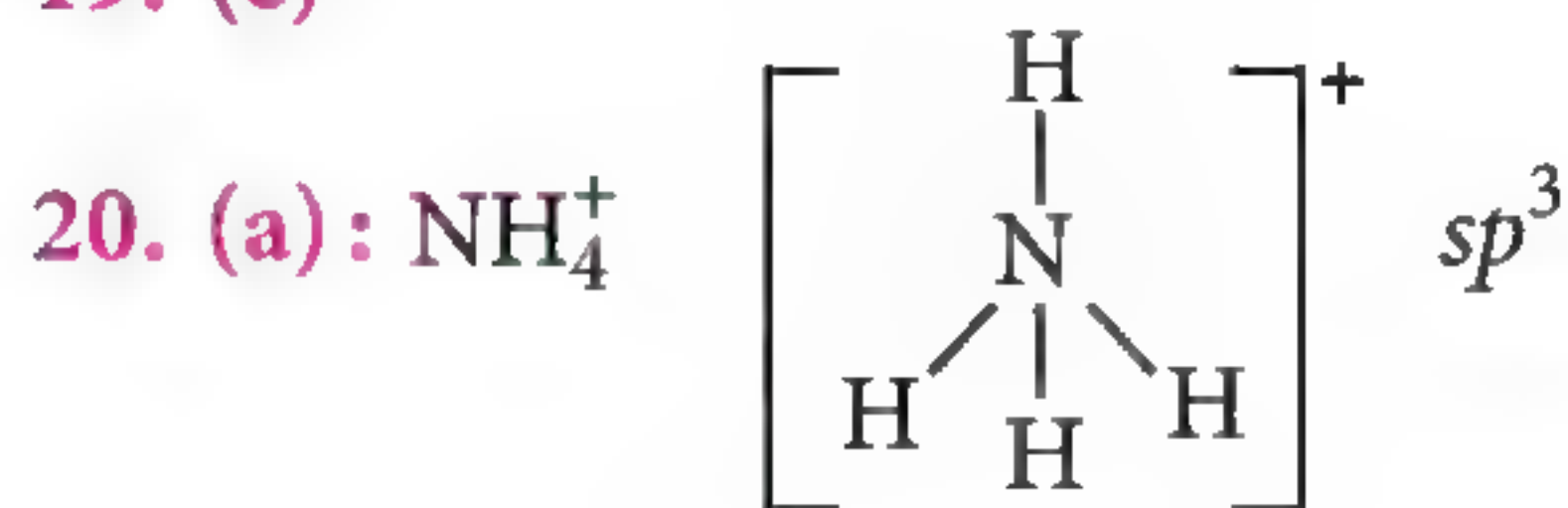
(Q) \rightarrow 3; Phosgene gas is COCl_2

(R) \rightarrow 1; Water glass is Na_2SiO_3

(S) \rightarrow 2; Borax gives beads of characteristic colour with copper salts on heating.

18. (a) : Outer electronic configuration of Cr atom is $3d^5 4s^1$, Au is $5d^{10} 6s^1$, Pd is $4d^{10} 5s^0$ and Gd is $4f^7 5d^1 6s^2$.

19. (c)



21. (9) : Let molecular weight of solute = M_1 and molecular weight of solvent = M_2

Mole fraction of solute = 0.1

Let solution is one litre

mass of solution = 2000 g (Given)

mass of solute = x

mass of solvent = (2000 - x) g

$$\text{Molarity of solution} = \frac{x}{M_1} / 1 \text{ litre}$$

$$\text{Molality of solution} = \frac{x}{M_1} / (2000 - x) \times 10^{-3} \\ = \frac{1000x}{(2000 - x)M_1}$$

At 298 K, Molarity = Molality

$$\frac{x}{M_1} = \frac{1000x}{(2000 - x)M_1}$$

$$2000 - x = 1000 \Rightarrow x = 1000 \text{ g}$$

$$\text{Number of moles of solute} = \frac{1000}{M_1}$$

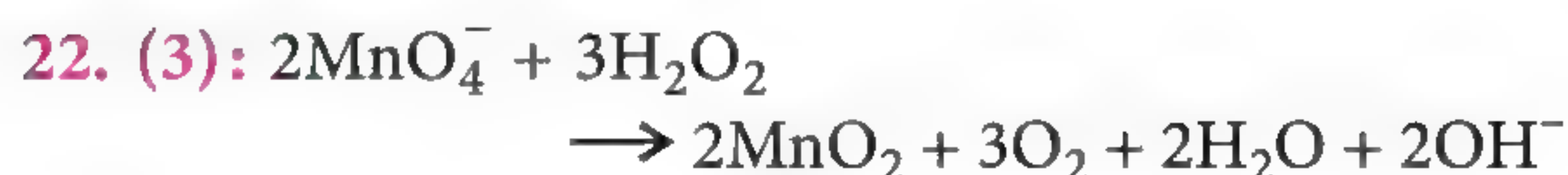
$$\text{Number of moles of solvent} = \frac{1000}{M_2}$$

Then mole fraction of solute is

$$\frac{\frac{1000}{M_1}}{\frac{1000}{M_1} + \frac{1000}{M_2}} \Rightarrow \frac{M_2}{M_1 + M_2} = 0.1$$

$$M_2 = 0.1 M_1 + 0.1 M_2$$

$$0.9 M_2 = 0.1 M_1 \Rightarrow \frac{M_1}{M_2} = 9$$



23. (6)

24. (8): Using formula, $x = kt$

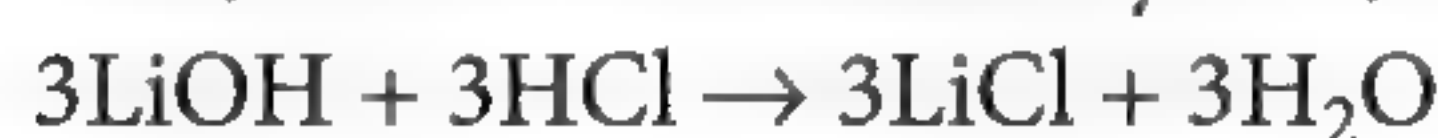
$$x = 0.1 - 0.076 = 0.024 \text{ M}$$

$$t = \frac{x}{k} = \frac{0.024}{3 \times 10^{-3}} = 8 \text{ sec.}$$

25. (4): Lithium nitride is decomposed by H_2O , the reaction is as follows:



Now, LiOH is neutralised by HCl , the reaction is as follows:

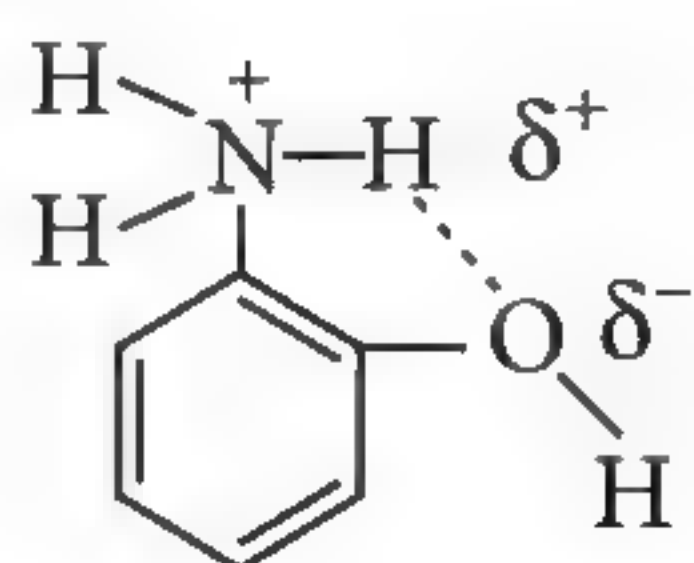


NH_3 is also neutralised by HCl , the reaction is as follows:



Total number of moles of HCl required = 3 (to neutralise LiOH) + 1 (to neutralise NH_3) = 4.

26. (5): Due to ortho-effect, *o*-substituted anilines are weaker bases than aniline. However, *o*-aminophenol is more basic than aniline due to stabilisation of the anilinium ion by H-bonding while *m*-aminophenol is less basic than aniline due to $-I$ -effect of the $-\text{OH}$ group at *m*-position.



Thus, the five amines which are more basic than aniline are:

m- and *p*-toluidine; *p*-anisidine and *o*- and *p*-aminophenol.



$$K_a = \frac{[\text{HCOO}^-][\text{H}_3\text{O}^+]}{[\text{HCOOH}]} = \frac{[\text{H}_3\text{O}^+]^2}{[\text{HCOOH}]}$$

$$2 \times 10^{-4} = \frac{[\text{H}_3\text{O}^+]^2}{0.01} \text{ or } [\text{H}_3\text{O}^+]^2 = 2 \times 10^{-6}$$

$$\text{or } [\text{H}_3\text{O}^+] = 1.4 \times 10^{-3} \text{ mol L}^{-1}$$

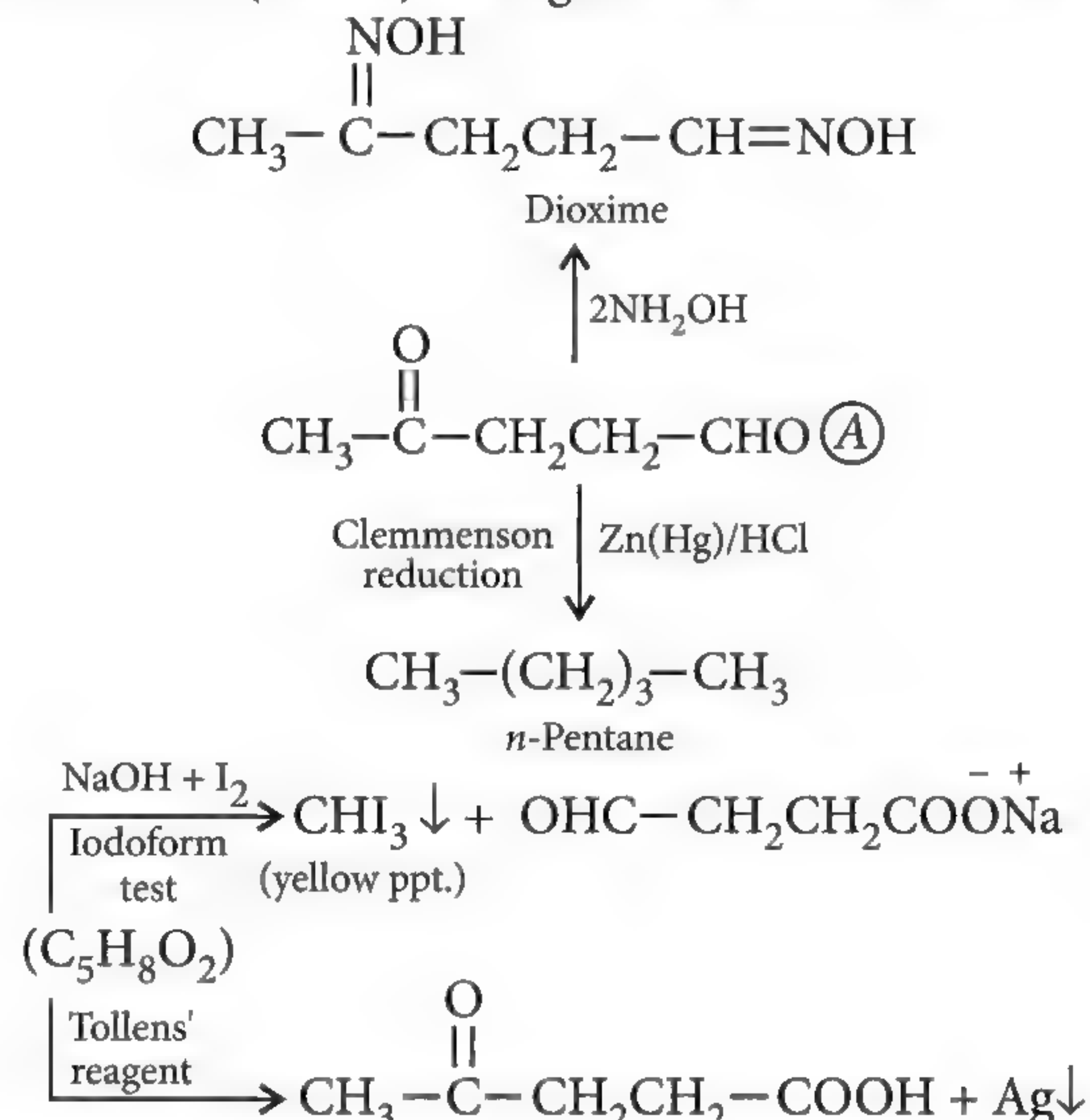
28. (1): (i) The compound gives positive iodoform

test indicating the presence of $\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-$ group.

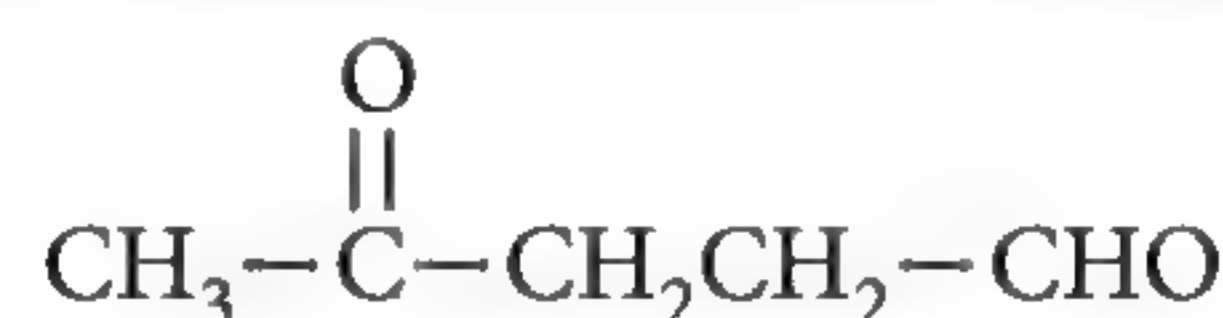
(ii) It also gives positive Tollens' test indicating the presence of $-\text{CHO}$ group.

(iii) The presence of one keto and one aldehydic group in the compound is indicated by its reaction with NH_2OH forming a dioxime.

(iv) Both keto as well as aldehydic group can be reduced to hydrocarbon (alkane) through Clemmenson reduction.



Hence, the structure of the given compound A is



\therefore The number of ketonic group is 1.

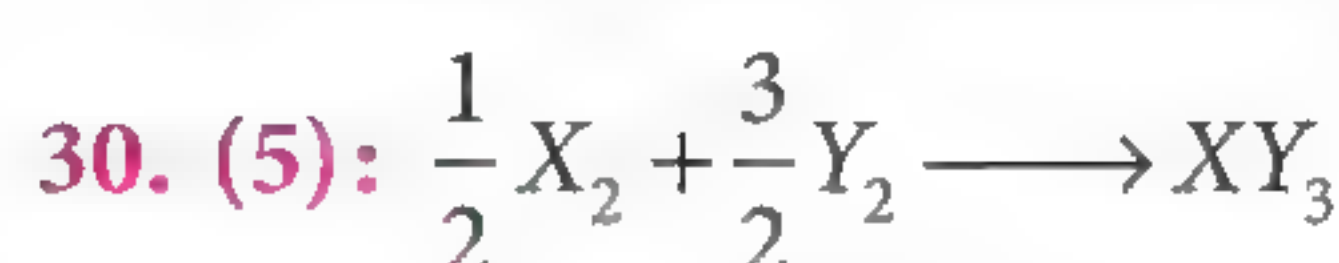
29. (1): $\frac{x}{m} = k \cdot p^{1/n}$ or $\log \frac{x}{m} = \log k + \frac{1}{n} \log p$

$$\text{Slope} = \frac{1}{n} = \tan 45^\circ = 1 \text{ or } n = 1$$

$$\text{Intercept} = \log k = 0.3010 \text{ or } k = 2$$

$$\text{Hence, at } 0.5 \text{ atm, } \frac{x}{m} = 2 \times (0.5)^1 = 2 \times 0.5 = 1$$

\therefore Amount of gas absorbed per g of charcoal = 1 g



$$\Delta S_{\text{reaction}} = S_{\text{products}} - S_{\text{reactants}}$$

$$\Delta S_{\text{reaction}} = 50 - \left(\frac{3}{2} \times 40 + \frac{1}{2} \times 60 \right) = -40 \text{ J K}^{-1} \text{ mol}^{-1}$$

$$\Delta G = \Delta H - T\Delta S$$

At equilibrium, as $\Delta G = 0$

$$\therefore \Delta H = T\Delta S$$

$$\Rightarrow T = \frac{\Delta H}{\Delta S} = \frac{30 \times 10^3}{40} = 750 \text{ K}$$

$$\text{Now, } x^2 + 145x = 750$$

$$\therefore x = 5$$



CONCEPT MAP

CHEMISTRY VITALS

Physical Chemistry

Some Basic Concepts of Chemistry

- Atomic mass = $\frac{\text{Average mass of an atom}}{\frac{1}{12} \times \text{Mass of an atom of C-12}}$
- Number of gram atoms = $\frac{\text{Mass of an element in gram}}{\text{Gram atomic mass}}$
- Mass per cent (%) = $\frac{w_{\text{solute}}}{w_{\text{solution}}} \times 100$
- Mole fraction (x_A) = $\frac{n_A}{n_A + n_B}$, (x_B) = $\frac{n_B}{n_A + n_B}$
- Molarity (M) = $\frac{w_2 \times 1000}{M_2 \times V(\text{in mL})}$
- Molality (m) = $\frac{w_2 \times 1000}{M_2 \times w_1(\text{in g})}$
- Part per million (ppm) = $\frac{\text{Mass of A}}{\text{Mass of solution}} \times 10^6$

Structure of Atom

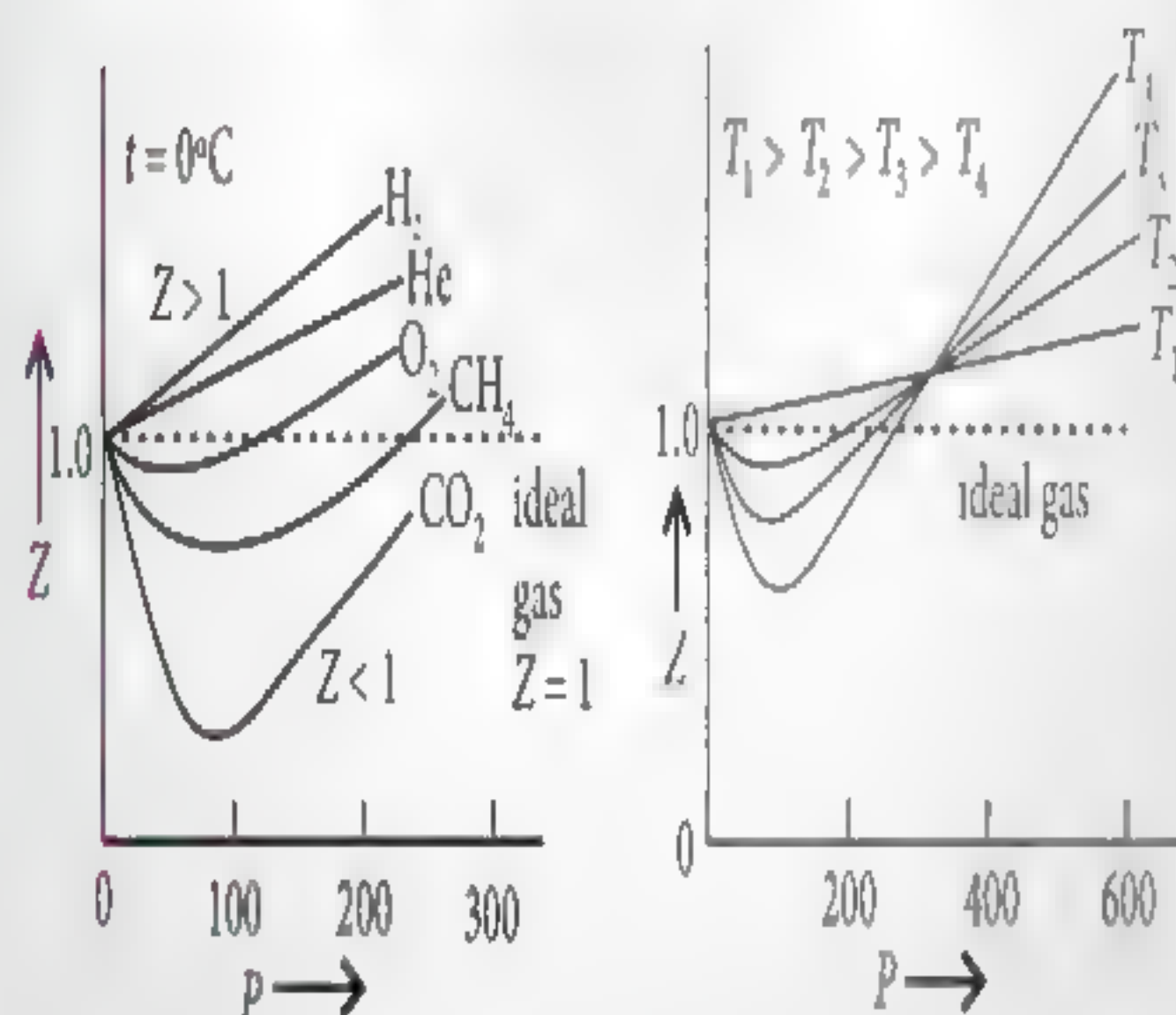
- $E = h\nu = \frac{hc}{\lambda}$; $\frac{1}{\lambda} = \bar{\nu} = R \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right) \text{ cm}^{-1}$;
where $R = 109,677 \text{ cm}^{-1}$
- $mvr = \frac{nh}{2\pi}$; $\Delta x \cdot \Delta p \geq \frac{h}{4\pi}$
- $r_n = \frac{n^2}{Z} \times 0.529 \text{ \AA}$; $E_n = \frac{-Z^2}{n^2} \times 1312 \text{ kJ/mol}$
- $v_n = \frac{Z}{n} \times 2.188 \times 10^8 \text{ cm/s}$;
- $K.E. = \frac{1}{2} m v^2$; $P.E. = \frac{-kZe^2}{r_n}$

Thermodynamics

- $\Delta U = q + w$
- $w_{\text{irr}} = -P_{\text{ext}}(V_f - V_i)$
- $w_{\text{rev}} = -2.303nRT \log \frac{V_2}{V_1} = -2.303nRT \log \frac{P_1}{P_2}$
- $\Delta H = \Delta E + \Delta n_g RT$; $C_v = \left(\frac{\partial E}{\partial T} \right)_V$; $C_p = \left(\frac{\partial H}{\partial T} \right)_P$
- $\Delta_{\text{sol}} H^\circ = \Delta_{\text{attice}} H^\circ + \Delta_{\text{hyd}} H^\circ$
- $\log \frac{P_2}{P_1} = \frac{\Delta H_{\text{vap}}}{2.303R} \left(\frac{T_2 - T_1}{T_1 T_2} \right)$
- $\Delta S = 2.303nR \log \left(\frac{V_2}{V_1} \right)$; $\Delta G = \Delta H - T\Delta S$
- $\Delta G^\circ = -2.303 RT \log K$; $\Delta G^\circ = -nFE_{\text{cell}}^\circ$

States of Matter

- $P_1 V_1 = P_2 V_2$; $\frac{V_1}{T_1} = \frac{V_2}{T_2}$; $\frac{P_1}{T_1} = \frac{P_2}{T_2}$; $\frac{V_1}{n_1} = \frac{V_2}{n_2}$; $PV = nRT$
- $d = \frac{PM}{RT}$; $r_1 = \sqrt{\frac{M_2}{M_1}}$; $d_2 = \frac{v_1 t_2}{v_2 t_1}$; $K.E. = \frac{3}{2} kT$
- $c_{\text{rms}} = \sqrt{3RT/M}$; $c_{\text{mp}} = \sqrt{2RT/M}$; $c_{\text{av}} = \sqrt{8RT/\pi M}$
- $T_b = a/Rb$; $T_c = 8a/27Rb$; $P_c = a/27b^2$; $V_c = 3b$
- Deviation From Ideal Gas Behaviour



- $Z = \frac{PV_m}{nRT}$; $P_c V_c = \frac{3}{8} RT_c$; $\left(P + \frac{n^2 a}{V^2} \right) (V - nb) = nRT$

Equilibrium

- For a reaction, $aA + bB \rightleftharpoons cC + dD$
- $\frac{k_f}{k_b} = K_c = \frac{[C]^c [D]^d}{[A]^a [B]^b}$; $K_p = \frac{P_C^c P_D^d}{P_A^a P_B^b}$; $K_p = K_c (RT)^{\Delta n_g}$
- $\log \frac{K_2}{K_1} = \frac{\Delta H}{2.303R} \left(\frac{T_2 - T_1}{T_1 T_2} \right)$; $K = \frac{C\alpha^2}{1-\alpha} \approx C\alpha^2$; $K = e^{-\Delta G^\circ/RT}$
- $K_w = K_a \times K_b$; $K_{sp} = [A^{x+}]^x \cdot [B^{y-}]^y$
- $\text{pH} = \frac{1}{2} [\text{p}K_w - \text{p}K_b - \log C]$ (for salts of strong acid and weak base)
- $\text{pH} = \frac{1}{2} [\text{p}K_w + \text{p}K_a - \log C]$ (for salts of weak acid and weak base)
- $\text{pH} = \frac{1}{2} [\text{p}K_w + \text{p}K_a + \log C]$ (for salts of weak acid and strong base)
- Binary electrolyte, $s = \sqrt{k_{sp}}$
- Ternary electrolyte, $s = \sqrt[3]{k_{sp}/4}$
- Quaternary electrolyte, $s = \sqrt[4]{k_{sp}/27}$
- 3:2 Type electrolyte; $s = \sqrt[5]{k_{sp}/108}$

Inorganic Chemistry

Classification of Elements and Periodicity in Properties

GROUP	PERIOD	
	Increases	Decreases
Ionisation enthalpy	Increases	Decreases
Electropositive character	Decreases	Increases
Metallic character	Decreases	Increases
Non-metallic character	Increases	Decreases
Reducing power	Decreases	Increases
Atomic size	Decreases	Increases
Electronegativity	Increases	Decreases
Basic nature of oxides	Decreases	Increases
Basic nature of hydrides	Decreases	Increases

- Basic strength and solubility:**
 $\text{LiOH} < \text{NaOH} < \text{KOH} < \text{RbOH} < \text{CsOH}$
 $\text{Be(OH)}_2 < \text{Mg(OH)}_2 < \text{Ca(OH)}_2 < \text{Sr(OH)}_2 < \text{Ba(OH)}_2$
 $\text{B(OH)}_3 < \text{Al(OH)}_3 < \text{Ga(OH)}_3 < \text{In(OH)}_3 < \text{Tl(OH)}_3$
- Stability:**
 $\text{Li}_2\text{CO}_3 < \text{Na}_2\text{CO}_3 < \text{K}_2\text{CO}_3 < \text{Rb}_2\text{CO}_3 < \text{Cs}_2\text{CO}_3$
 $\text{BeCO}_3 < \text{MgCO}_3 < \text{CaCO}_3 < \text{SrCO}_3 < \text{BaCO}_3$
 $\text{BeSO}_4 < \text{MgSO}_4 < \text{CaSO}_4 < \text{SrSO}_4 < \text{BaSO}_4$
 $\text{NaHCO}_3 < \text{KHCO}_3 < \text{RbHCO}_3 < \text{CsHCO}_3$
- Solubility:** $\text{BeCO}_3 > \text{MgCO}_3 > \text{CaCO}_3 > \text{SrCO}_3 > \text{BaCO}_3$
 $\text{BeSO}_4 > \text{MgSO}_4 > \text{CaSO}_4 > \text{SrSO}_4 > \text{BaSO}_4$
 (Almost insoluble)
- Stability of oxidation states:**
 $\text{B}^{3+} > \text{Al}^{3+} > \text{Ga}^{3+} > \text{In}^{3+} > \text{Tl}^{3+}$; $\text{B}^+ < \text{Al}^+ < \text{Ga}^+ < \text{In}^+ < \text{Tl}^+$;
 $\text{Ge}^{4+} > \text{Sn}^{4+} > \text{Pb}^{4+}$; $\text{Ge}^{2+} < \text{Sn}^{2+} < \text{Pb}^{2+}$
- Lewis acid character:**
 $\text{BF}_3 < \text{BCl}_3 < \text{BBr}_3 < \text{BI}_3$
- Catenation tendency:** $\text{C} >> \text{Si} > \text{Ge} \approx \text{Sn} >> \text{Pb}$
- Acidic strength:** Acidic strength of their oxides decreases down the group.

Chemical Bonding

Type of hybridisation	No. of hybrid orbitals	Shape of molecule	Bond angle	Examples
sp	2	Linear	180°	BaCl_2 , CO_2
sp^2	3	Trigonal planar	120°	SnCl_2 , BF_3
sp^3	4	Tetrahedral	109.5°	CH_4 , SiF_4
dsp^2	4	Square planar	90°	$[\text{Ni}(\text{CN})_4]^{2-}$
dsp^3 or sp^3d	5	Trigonal bipyramidal	120° and 90°	PCl_5 , SbCl_5
d^2sp^3 or sp^3d^2	6	Octahedral	90° and 180°	SF_6
d^3sp^3 or sp^3d^3	7	Pentagonal bipyramidal	72° and 90°	IF_7

Organic Chemistry

Some Basic Principles and Techniques

- Preference order of functional groups:** Carboxylic acids > sulphonic acids > anhydrides > esters > acid chlorides > acid amides > nitriles > isocyanides > aldehydes > ketones > alcohols > phenols > thiols > amines > alkenes > alkynes
- Stability order:**
 Carbocations: $3^\circ > 2^\circ > 1^\circ > \text{CH}_3$; Carbanions: $\text{CH}_3 > 1^\circ > 2^\circ > 3^\circ$
 Free radicals: $3^\circ > 2^\circ > 1^\circ > \text{CH}_3$
- I effect:** $-\text{NO}_2 > -\text{CN} > -\text{COOH} > -\text{F} > -\text{Cl} > -\text{Br} > -\text{I} > -\text{H}$
- +I effect:** $(\text{CH}_3)_3\text{C} > (\text{CH}_3)_2\text{CH} > \text{CH}_3\text{CH}_2 > \text{CH}_3 > \text{D} > \text{H}$
- +R effect:** $-\text{OH}, -\text{OR}, -\text{SH}, -\text{SR}, -\text{NH}_2, -\text{NHR}, -\text{NR}_2, -\text{Cl}, -\text{Br}, -\text{I}$
- R effect:** $-\text{COOH}, >\text{C}=\text{O}, -\text{CHO}, -\text{COOR}, -\text{CN}, -\text{NO}_2$

The s- and p-Block Elements

Hydrogen

- x volume of H_2O_2 means 1 mL of such solution on decomposition by heat produces x mL of oxygen at NTP.
- Volume strength = $5.6 \times N$
 $= 5.6 \times \frac{\% \text{ of strength}}{\text{eq. wt. of } \text{H}_2\text{O}_2} \times 10$
 $= 5.6 \times \frac{\text{strength in g L}^{-1}}{\text{eq. wt. of } \text{H}_2\text{O}_2}$
- Volume strength
 $= 11.2 \times \frac{\% \text{ of strength}}{\text{Mol. wt. of } \text{H}_2\text{O}_2} \times 10$
 $= 5.6 \times \frac{\text{strength in g L}^{-1}}{\text{eq. wt. of } \text{H}_2\text{O}_2}$

Hydrocarbons

- Conformations of ethane:** Staggered > Skew or Gauche > Eclipsed
- Conformations of cyclohexane:** Chair > Twist-boat > Boat > Half-chair
- Stability order of different alkenes:**
 $\text{R}_2\text{C}=\text{CR}_2 > \text{R}_2\text{C}=\text{CHR} > \text{R}_2\text{C}=\text{CH}_2 >$
 $\text{H}-\text{C}=\text{C}-\text{H} > \text{H}-\text{C}=\text{C}-\text{R}$
 $> \text{RCH}=\text{CH}_2 > \text{CH}_2=\text{CH}_2$
- Acidity:** Alkynes > alkenes > alkanes (as s-character \propto acidity).
- Alkynes undergo electrophilic and nucleophilic addition reactions.
- Aromatic compounds:** Cyclic, completely conjugated system of p-orbitals in ring, planar, $(4n+2)\pi$ e's.
- Anti-aromatic compounds:** Cyclic, completely conjugated system of p-orbitals in ring, planar, $4n\pi$ e's.
- Non-aromatic compounds:** Does not satisfy any one of the above conditions.

CUET (UG)

PRACTICE PAPER 2022

Section II of CUET (UG) is Domain specific. In this section of Chemistry 40 questions to be attempted out of 50.

Time : 45 minutes

- P_4O_{10} is not used to dry NH_3 gas because
 - P_4O_{10} reacts with moisture in NH_3
 - P_4O_{10} is not a drying agent
 - P_4O_{10} is acidic and NH_3 is basic
 - P_4O_{10} is basic and NH_3 is acidic.
- When NaCl crystal is doped with $MgCl_2$, the nature of defect produced is
 - interstitial defect
 - Schottky defect
 - Frenkel defect
 - none of these.
- Number of moles of $K_2Cr_2O_7$ reduced by one mole of Sn^{2+} ion is
 - $\frac{1}{3}$
 - 3
 - $\frac{1}{6}$
 - 6
- Which of the following is correct for Freundlich adsorption isotherm?
 - $x/m \propto p^1$
 - $x/m \propto p^{1/n}$
 - $x/m \propto p^0$
 - All the above are correct for different ranges of pressure
- According to Kohlrausch law, the limiting value of molar conductivity of an electrolyte, A_2B is
 - $\lambda_{(A^+)}^\infty + \lambda_{(B^-)}^\infty$
 - $\lambda_{(A^+)}^\infty - \lambda_{(B^-)}^\infty$
 - $2\lambda_{(A^+)}^\infty + \frac{1}{2}\lambda_{(B^-)}^\infty$
 - $2\lambda_{(A^+)}^\infty + \lambda_{(B^{2-})}^\infty$
- Which of the following is an example of S_N2 reaction?
 - $CH_3Br + OH^- \rightarrow CH_3OH + Br^-$
 - $CH_3-\underset{\text{Br}}{\underset{|}{CH}}-CH_3 + OH^- \rightarrow CH_3-\underset{\text{OH}}{\underset{|}{CH}}-CH_3 + Br^-$
 - $CH_3CH_2OH \xrightarrow{-H_2O} CH_2=CH_2$
 - $(CH_3)_3C-Br + OH^- \rightarrow (CH_3)_3C-OH + Br^-$
- Artificial sweetener which is stable under cold conditions only is
 - saccharin
 - sucralose
 - aspartame
 - alitame.
- Which of the following will have a *meso*-isomer?
 - 2-Chlorobutane
 - 2-Hydroxypropanoic acid
 - 2,3-Dichloropentane
 - 2,3-Dichlorobutane
- Oxidising action increases in the following order
 - $Cl < Br < I < F$
 - $Cl < I < Br < F$
 - $I < F < Cl < Br$
 - $I < Br < Cl < F$
- Which of the following pairs shows a negative deviation from Raoult's law?
 - Acetone-benzene
 - Acetone-ethanol
 - Acetone-chloroform
 - Benzene-methanol
- Which of the following alcohols will yield the corresponding alkyl chloride on reaction with concentrated HCl at room temperature?
 - $CH_3CH_2-CH_2-OH$
 - $CH_3CH_2-\underset{\text{CH}_3}{\underset{|}{CH}}-OH$
 - $CH_3CH_2-\underset{\text{CH}_3}{\underset{|}{CH}}-CH_2OH$
 - $CH_3CH_2-\underset{\text{CH}_3}{\underset{|}{C}}-OH$
- Non-lanthanoid atom is
 - La
 - Lu
 - Pr
 - Pm
- If a first order reaction is completed 20% in 500 s. How long would it take for the reaction to go to 60% completion?
 - 2054 s
 - 3000 s
 - 1000 s
 - 2000 s

14. Propanal on treatment with dilute sodium hydroxide forms

- (a) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CHO}$
 (b) $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_2\text{CH}_2\text{CHO}$
 (c) $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}(\text{CH}_3)\text{CHO}$
 (d) $\text{CH}_3\text{CH}_2\text{COONa}$

15. The reaction of Xe with an excess of F_2 at high pressure and 300°C yields

- (a) XeF_2 (b) XeF_4
 (c) XeF_6 (d) XeF_3

16. Higher order (>3) reactions are rare due to

- (a) shifting of equilibrium towards reactants due to elastic collisions
 (b) loss of active species on collision
 (c) low probability of simultaneous collision of more than three reacting species
 (d) increase in entropy and activation energy as more molecules are involved.

17. $\text{R}-\text{OH} + \text{HX} \rightarrow \text{RX} + \text{H}_2\text{O}$

In the above reaction, the reactivity of alcohols is

- (a) tertiary $>$ secondary $>$ primary
 (b) tertiary $<$ secondary $<$ primary
 (c) tertiary $>$ primary $>$ secondary
 (d) secondary $>$ primary $>$ tertiary

18. Which of the following is incorrect?

- (a) O_2 is weaker oxidant than O_3 .
 (b) O_2 has smaller bond length than O_3 .
 (c) Both O_2 and O_3 are paramagnetic.
 (d) O_2 is linear and O_3 is angular in shape.

19. Three elements X, Y and Z crystallised in cubic solid lattice with X atoms at corners, Y atoms at cube centre and Z atoms at the edges. The formula of the compound is

- (a) XYZ (b) XY_3Z
 (c) XYZ_3 (d) X_3YZ

20. Lanthanoids are

- (a) 14 elements in the sixth period (at. no. = 90 - 103) in which $4f$ -subshell is being filled
 (b) 14 elements in the seventh period (at. no. = 90 - 103) in which $5f$ -subshell is filled
 (c) 14 elements in the sixth period (at. no. = 58 - 71) in which $4f$ -subshell is filled
 (d) 14 elements in the seventh period (at. no. = 50 - 71) in which $4f$ -subshell is filled.



PUBLIC NOTICE CUET (UG) 2022

Sub : Conduct of the Common University Entrance Test CUET (UG)-2022 for Under Graduate Programmes in Central Universities for the Academic Session 2022-23

National Testing Agency has been entrusted with the responsibility of conducting the Undergraduate entrance tests for all the Central Universities (CUs) for the academic session 2022-2023. CUET will provide a single window opportunity to students to seek admission in any of the Central Universities (CUs) across the country.

The CUET (UG) - 2022 will be conducted in Computer Based Test (CBT) Mode. The aspirants who desire to appear for the test, may refer to the Information Bulletin for admission to Undergraduate programmes of the desired Central Universities (CUs) for admission into the Undergraduate Programmes.

The details of the programmes offered by Central Universities (CUs) are being made available on their respective websites.

Examination Structure for CUET (UG) - 2022

CUET (UG) - 2022 will consist of the following 4 Sections :

- Section IA - 13 Languages
- Section IB - 20 Languages
- Section II - 27 Domain Specific Subjects
- Section III - General Test

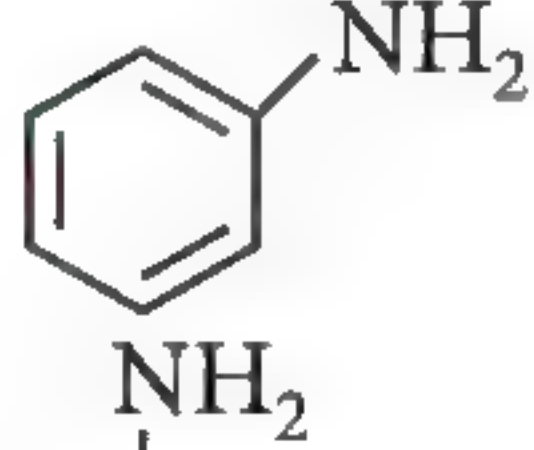
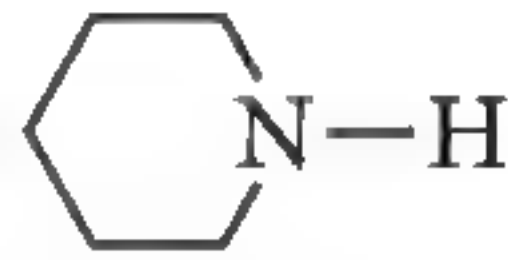
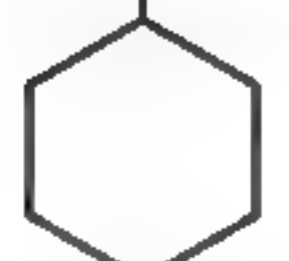
Choosing options from each Section is not mandatory. Choices should match the requirements of the desired University.

- A Candidate can choose a maximum of **any 3 languages** from Section IA and Section IB taken together. However, the third language chosen needs to be in lieu of 6th domain specific subject chosen by the candidate - as applicable **(so the maximum number of tests to be taken remains 9 only i.e. 2 Languages + 6 Domain Specific Subjects + 1 General Test OR 3 Languages + 5 Domain Specific Subjects + 1 General Test: flexibility being provided to help a candidate apply for many Universities depending on their eligibility conditions).**
- Section II offers 27 Subjects, out of which a candidate may choose a maximum of 6 Subjects.
- Section III comprises **General Test**.
- For choosing Languages from Section IA and IB and domain specific Subjects from Section II and General Test under Section III, the Candidate must refer to the requirements of his/her intended University.

Mode of the Test	Computer Based Test-CBT
Test Pattern	Objective type with Multiple Choice Questions
Medium	13 languages (Tamil, Telugu, Kannada, Malayalam, Marathi, Gujarati, Odiya, Bengali, Assamese, Punjabi, English, Hindi and Urdu)
Syllabus	Section IA & IB: Language to be tested through Reading Comprehension (based on different types of passages—Factual, Literary and Narrative [Literary Aptitude & Vocabulary])
	Section II : As per NCERT model syllabus as applicable to Class XII only
	Section III : General Knowledge, Current Affairs, General Mental Ability, Numerical Ability, Quantitative Reasoning (Simple application of basic mathematical concepts arithmetic/algebra geometry/mensuration/stat taught till Grade 8), Logical and Analytical Reasoning
Registration	Registration will be online at https://cuetsamarth.ac.in/ .

Schedule of Examination

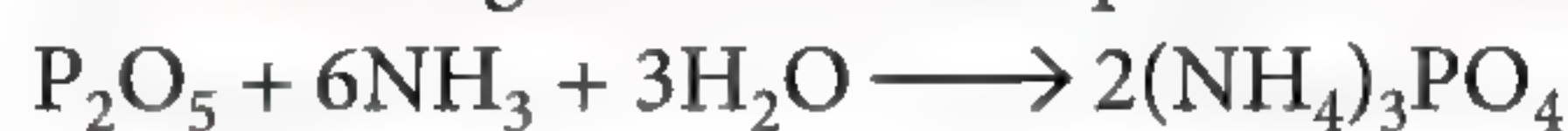
Examination will be conducted on multiple days in two shifts, depending on the number of Candidates and Languages/Tests taken by them.

21. Chlorobenzene can be obtained from benzene diazonium chloride by
 (a) Gattermann's reaction
 (b) Friedel-Crafts reaction
 (c) Wurtz reaction
 (d) Fitting reaction.
22. Aluminium is more reactive than iron but aluminium is less easily corroded than iron because
 (a) aluminium is a noble metal
 (b) iron undergoes reaction easily with water
 (c) aluminium with oxygen forms a protective oxide layer
 (d) iron forms mono and divalent ions.
23. Which of the following is a chelating agent?
 (a) Thiosulphato (b) Oxalato
 (c) Hydrazinium ion (d) Phosphine
24. A binary solid (A^+B^-) has a rock salt structure. If the edge length is 400 pm and radius of cation is 75 pm the radius of anion is
 (a) 100 pm (b) 125 pm
 (c) 250 pm (d) 325 pm
25. Which of the following statements is correct?
 (a) True particles are able to pass through filter paper and not in semipermeable membrane.
 (b) Colloidal particles are able to pass through filter paper and not in semipermeable membrane.
 (c) Both true and colloidal particles are able to pass through filter paper and semipermeable membrane.
 (d) Both true and colloidal particles are not able to pass through filter paper and semipermeable membrane
26. Ketones (R_1COR_2); $R_1 = R_2 =$ alkyl group, can be obtained in one step by
 (a) hydrolysis of esters
 (b) oxidation of primary alcohols
 (c) oxidation of secondary alcohols
 (d) reaction of acid halides and alcohols.
27. Extent of physisorption of a gas increases with
 (a) increase in temperature
 (b) decrease in temperature
 (c) decrease in surface area of adsorbent
 (d) decrease in strength of van der Waals' forces.
28. Which of the following is the weakest Bronsted base?
 (a)  (b) 
 (c)  (d) CH_3NH_2
29. Two faradays of electricity are passed through a solution of $CuSO_4$. The mass of copper deposited at the cathode is (at. mass of Cu = 63.5 amu)
 (a) 2 g (b) 127 g (c) 0 g (d) 63.5 g
30. Arrange the following complex ions in increasing order of crystal field splitting energy (Δ_o).
 $[CrCl_6]^{3-}$, $[Cr(CN)_6]^{3-}$, $[Cr(NH_3)_6]^{3+}$
 (a) $[Cr(NH_3)_6]^{3+} < [CrCl_6]^{3-} < [Cr(CN)_6]^{3-}$
 (b) $[CrCl_6]^{3-} < [Cr(NH_3)_6]^{3+} < [Cr(CN)_6]^{3-}$
 (c) $[CrCl_6]^{3-} < [Cr(CN)_6]^{3-} < [Cr(NH_3)_6]^{3+}$
 (d) $[Cr(NH_3)_6]^{3+} < [Cr(CN)_6]^{3-} < [CrCl_6]^{3-}$
31. 12 g of urea is dissolved in 1 litre of water and 68.4 g of sucrose is dissolved in 1 litre of water. The lowering of vapour pressure of first reaction is
 (a) equal to second (b) greater than second
 (c) less than second (d) double that of second.
32. 1,3-Dibromopropane reacts with metallic zinc to form
 (a) propene (b) propane
 (c) cyclopropane (d) hexane.
33. The addition of a catalyst during a chemical reaction alters which of the following quantities?
 (a) Enthalpy (b) Activation energy
 (c) Entropy (d) Internal energy
34. Which of the following steps will be required for the conversion of ethanal into butane-1, 3-diol?
 (a) Acylation, reduction
 (b) Cross aldol condensation, dehydration
 (c) Aldol condensation, oxidation
 (d) Aldol condensation, reduction
35. When initial concentration of a reactant is doubled in a reaction, its half-life period is not affected. The order of the reaction is
 (a) second
 (b) more than zero but less than first
 (c) zero
 (d) first.
36. Ethylamine reacts with nitrous acid to form
 (a) C_2H_5OH only (b) C_2H_5OH , N_2 , H_2O
 (c) $C_2H_5N_2^+Cl^-$ only (d) C_2H_5NHOH , NH_3

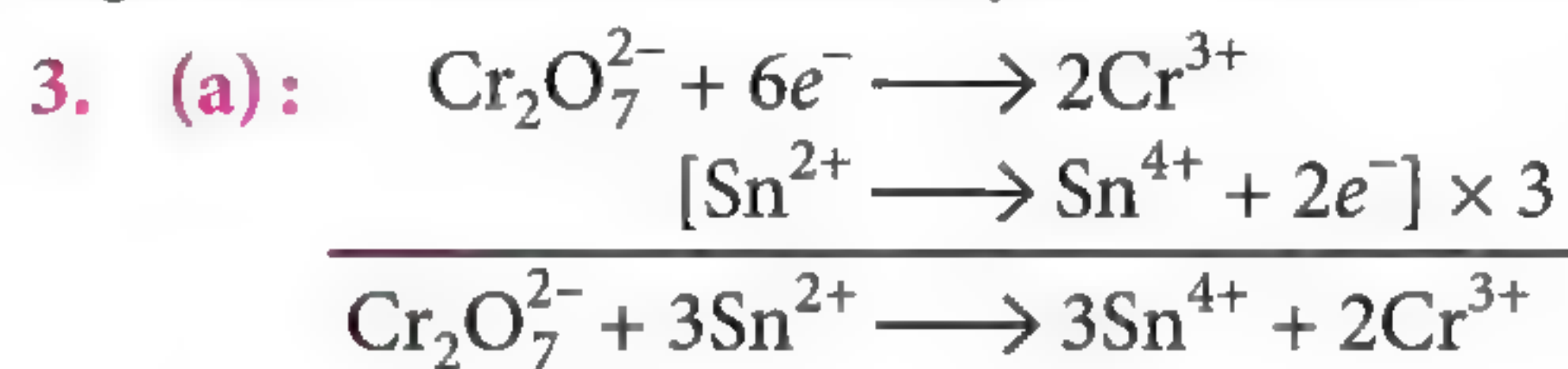
37. Which of the following metals, present as impurity passes into solution during electro-refining of copper?
 (a) Zinc (b) Silver
 (c) Gold (d) Platinum
38. Sucrose (cane sugar) is a disaccharide. One molecule of sucrose on hydrolysis gives _____.
 (a) 2 molecules of glucose
 (b) 2 molecules of glucose + 1 molecules of fructose
 (c) 1 molecule of glucose + 1 molecules of fructose
 (d) 2 molecules of fructose
39. Norethindrone and ethynylestradiol are used as
 (a) antacids (b) antifertility drugs
 (c) antimicrobials (d) antibiotics.
40. What is the main composition of matte?
 (a) CuS (b) Cu₂S
 (c) CuO (d) Cu₂O
41. Terylene is a polymer of ethylene glycol and
 (a) phthalic acid (b) terephthalic acid
 (c) adipic acid (d) 1,6-hexadamine.
42. The vacant space in *bcc* lattice unit cell is
 (a) 48% (b) 23%
 (c) 32% (d) 26%
43. An organic compound of molecular formula C₄H₁₀O does not react with sodium. With excess of HI, it gives only one type of alkyl halide. The compound is
 (a) ethoxyethane (b) 2-methoxypropane
 (c) 1-methoxypropane (d) 1-butanol.
44. Which of the following complexes is diamagnetic?
 (a) [Mn(H₂O)₆]²⁺ (b) [Cu(H₂O)₆]³⁺
 (c) [Co(NH₃)₆]³⁺ (d) [Co(H₂O)₆]²⁺
45. Which of the following is not an artificial sweetening agent?
 (a) Sucralose (b) Alitame
 (c) Sodium benzoate (d) Aspartame
46. Based upon the technique of reverse osmosis, the approximate pressure required to desalinate sea water containing 2.5% (mass/volume) NaCl at 27°C will be
 (a) 10.5 atm (b) 21 atm
 (c) 2.1 atm (d) 1.05 atm
47. Which reagent is used to convert 2-butanone into propanoic acid?
 (a) NaOH, I₂/H⁺ (b) Tollens' reagent
 (c) Fehling's solution (d) NaOH, NaI/H⁺
48. Which of the following statements is not true about low density polythene?
 (a) Tough but flexible
 (b) Chemically reactive
 (c) Poor conductor of electricity
 (d) Highly branched structure
49. In Fe(CO)₅, the Fe – C bond possesses
 (a) π -character only (b) both σ and π characters
 (c) ionic character (d) σ -character only.
50. In nucleic acids, the individual nucleotides are linked through
 (a) peptide linkage
 (b) phosphodiester linkage
 (c) glycosidic linkage
 (d) hydrogen bonds.

SOLUTIONS

1. (c): P₄O₁₀ is acidic and NH₃ is basic in nature and the following reaction takes place between the two.



2. (d): This is a type of defect in ionic crystalline solids. This is different from that of defects in stoichiometric and non-stoichiometric crystals. Cationic vacancies developed due to introduction of impurity causes higher electrical conductivity of ionic solids.



\therefore 3 moles of Sn²⁺ ions reduce one mole of K₂Cr₂O₇

\therefore 1 mole of Sn²⁺ ion reduce $\frac{1}{3}$ mole of K₂Cr₂O₇

4. (d): According to Freundlich adsorption isotherm, $x/m \propto p^1$ (at low pressure)

$x/m \propto p^{1/n}$ (at intermediate pressure)

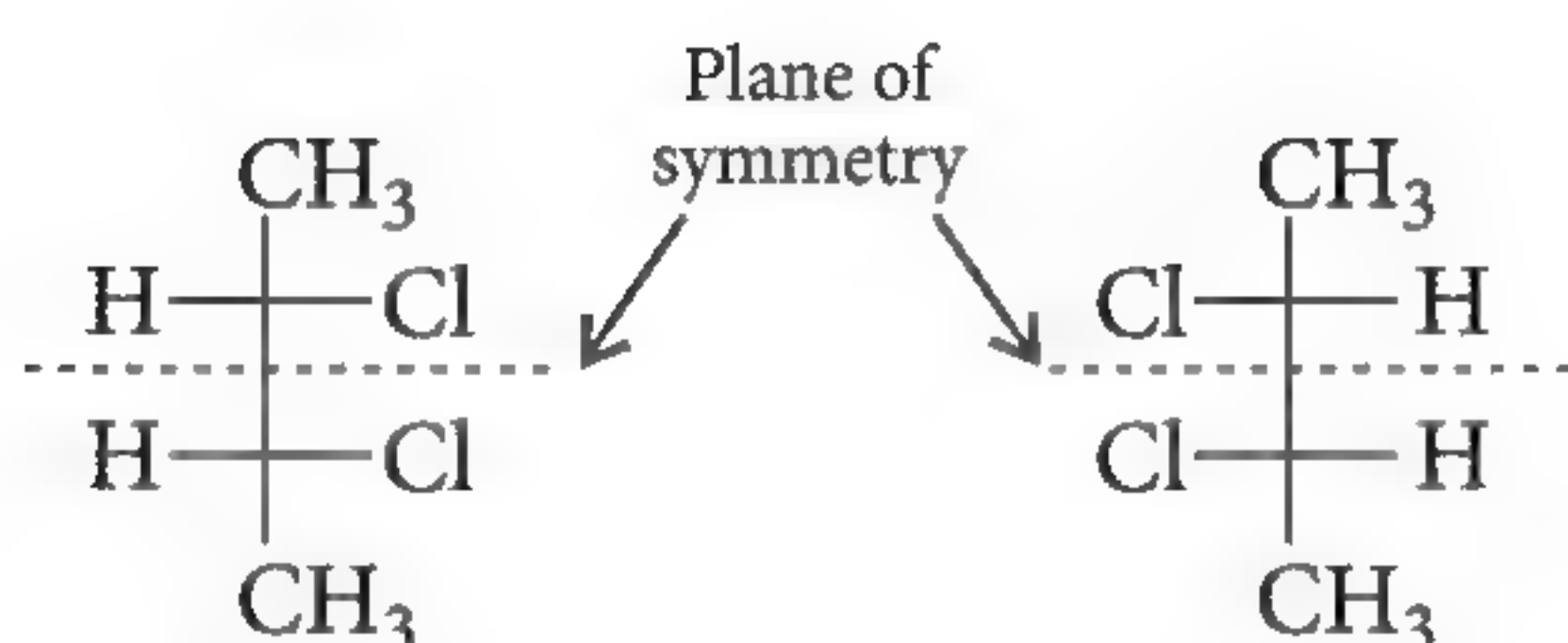
$x/m \propto p^0$ (at high pressure)

5. (d)

6. (a)

7. (c): Aspartame is stable under cold conditions but unstable at cooking temperature.

8. (d): 2,3-Dichlorobutane contains a plane of symmetry *i.e.*, the upper half of the molecule is the mirror image of the lower half. The rotation of one half of the molecule will therefore exactly counter balance the rotation of the other half, causing the molecule to be optically inactive. Such an internally compensated molecule is said to be a *meso*-form.



9. (d): Oxidising action of halogens decreases down the group hence, follows the order : $I < Br < Cl < F$

10. (c): When acetone and chloroform are mixed, hydrogen bonding takes place between the two due to which escaping tendency of either of the liquid solution becomes less.

11. (d)

12. (a): Lanthanum (La) is a *d*-block element which resembles lanthanoids.

13. (a): In first case,

Given that, $t = 500$ s; Let $a = 100$

$$a - x = 80\% \text{ of } 100 = 100 \times \frac{80}{100} = 80$$

For first order reaction,

$$k = \frac{2.303}{t} \log \frac{[A]_0}{[A]}$$

$$k = \frac{2.303}{500} \log \left(\frac{100}{80} \right)$$

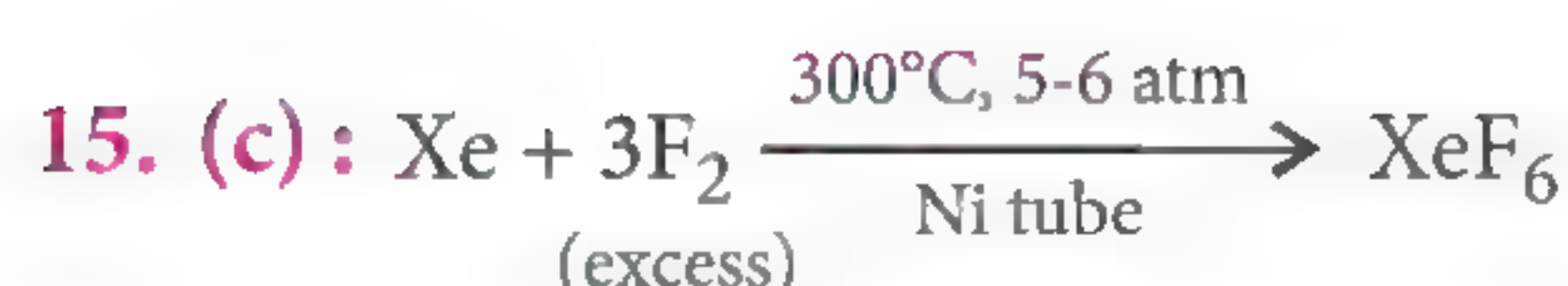
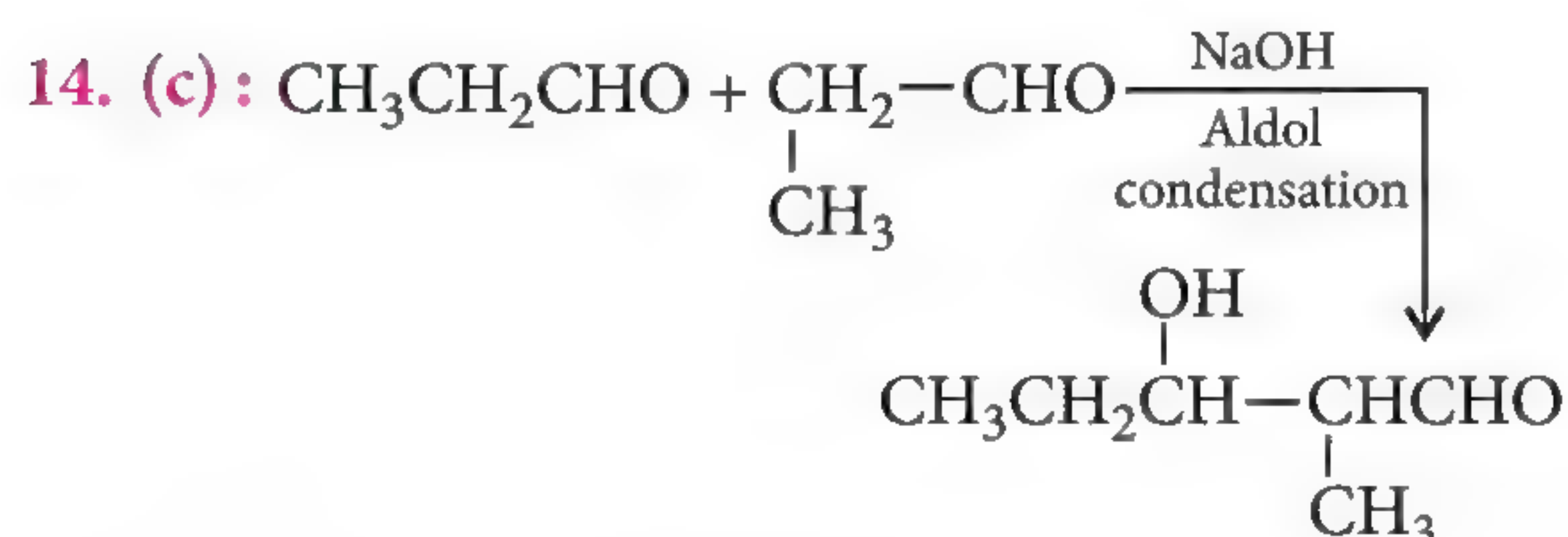
$$k = 0.000446 \text{ s}^{-1}$$

In second case, $a = 100$

$$a - x = 40\% \text{ of } 100 = 100 \times \frac{40}{100} = 40$$

$$\therefore t = \frac{2.303}{k} \log \frac{a}{a-x}$$

$$t = \frac{2.303}{0.000446} \log \frac{100}{40} ; t = 2054 \text{ S}$$



16. (c): The reactions of higher order are very rare because of the less chances of the molecules to come together simultaneously and collide.

17. (a): Reactions of alcohols involving cleavage of C – OH bond follow the reactivity order :

Tertiary > secondary > primary, according to the stability of carbocation intermediate.

18. (c): O_3 is not paramagnetic, it is diamagnetic.

19. (c): Number of X-atoms (present at corners) per unit

$$\text{cell} = \frac{1}{8} \times 8 = 1$$

Number of Y-atoms (present at cube centre) per unit cell = 1

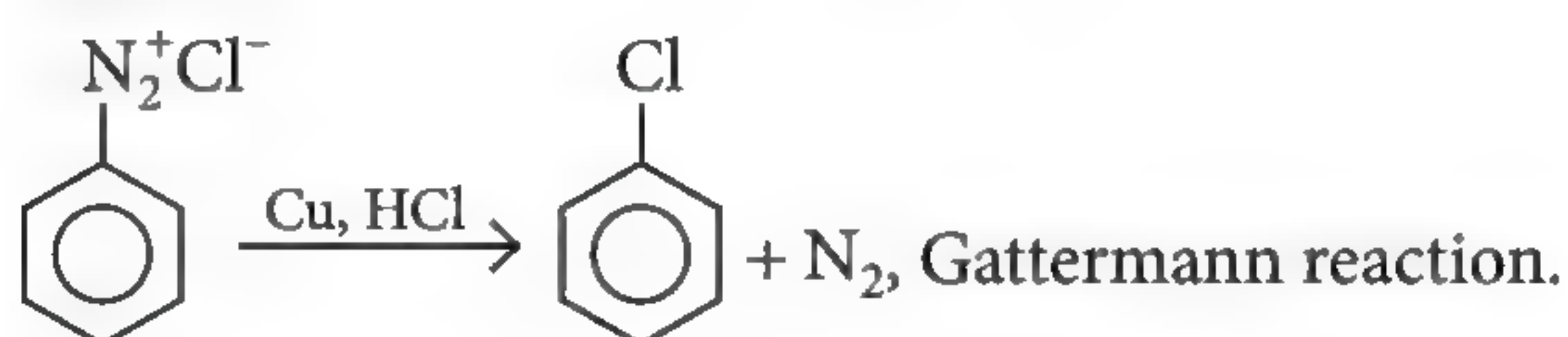
Number of Z-atoms (present at edge centre) per unit

$$\text{cell} = \frac{1}{4} \times 12 = 3$$

$\therefore X : Y : Z = 1 : 1 : 3$. Thus, formula is XYZ_3 .

20. (c): Lanthanoids are 14 elements in the sixth period ($Z = 58 - 71$) in which 4*f*-sublevel is filled.

21. (a): Chlorobenzene can be obtained from benzene diazonium chloride by Sandmeyer's or Gattermann reaction.



22. (c)

23. (b): Oxalato is a chelating agent since it is a bidentate ligand.

24. (b): Edge length = $2(r_+ + r_-)$

$$(75 + r_-) = \frac{400}{2}$$

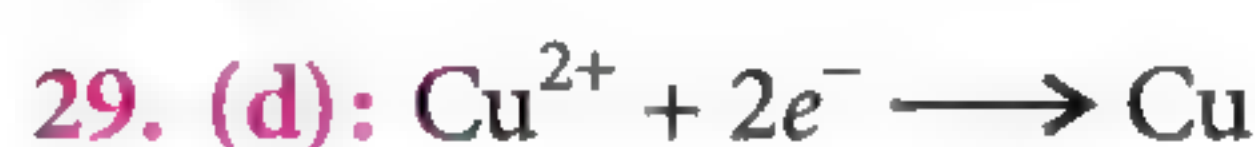
$$r_- = 200 - 75 = 125 \text{ pm.}$$

25. (b): Colloidal particles can pass through ordinary filter paper and not through semipermeable membrane.

26. (c)

27. (b): Degree of physisorption increases with decrease in temperature.

28. (a)



2 F charge deposits 1 mol of Cu i.e., 2 F of electricity deposits 63.5 g mass of Cu at the cathode.

30. (b): Cl^- is a weak field ligand while CN^- is a strong field ligand. Hence, the order of crystal field splitting energy (Δ_o) is

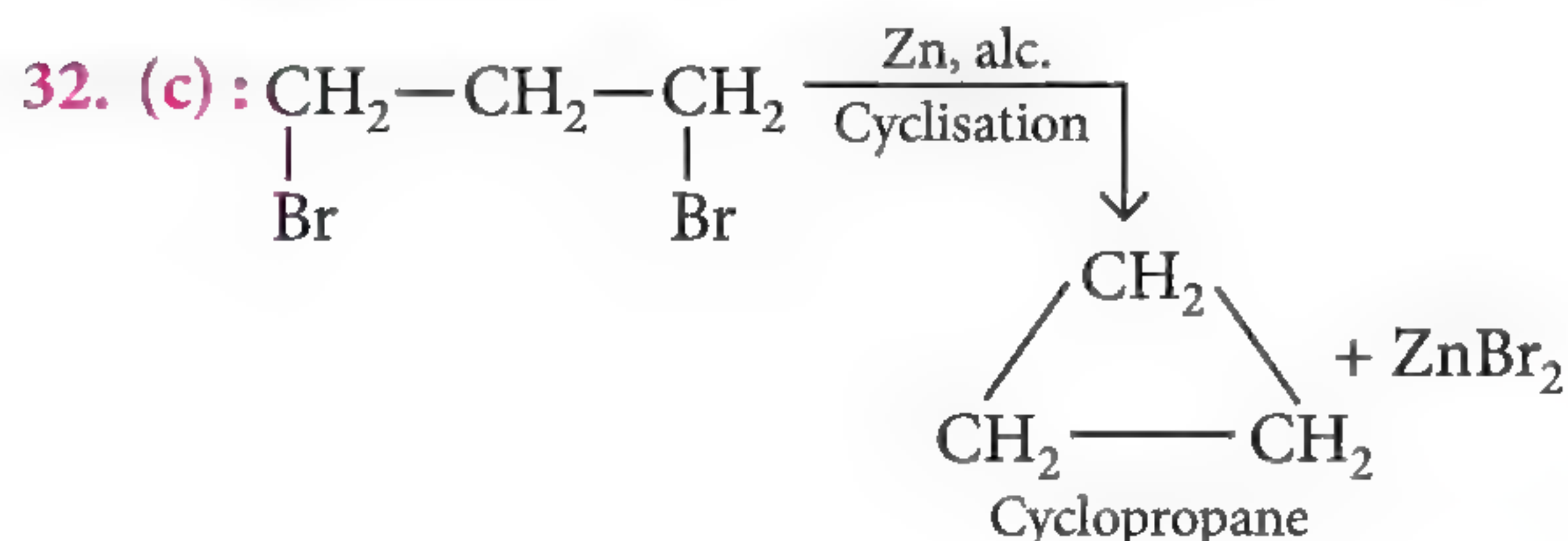


31. (a): Number of moles of urea in 1 litre water

$$= \frac{12}{60} = \frac{1}{5}$$

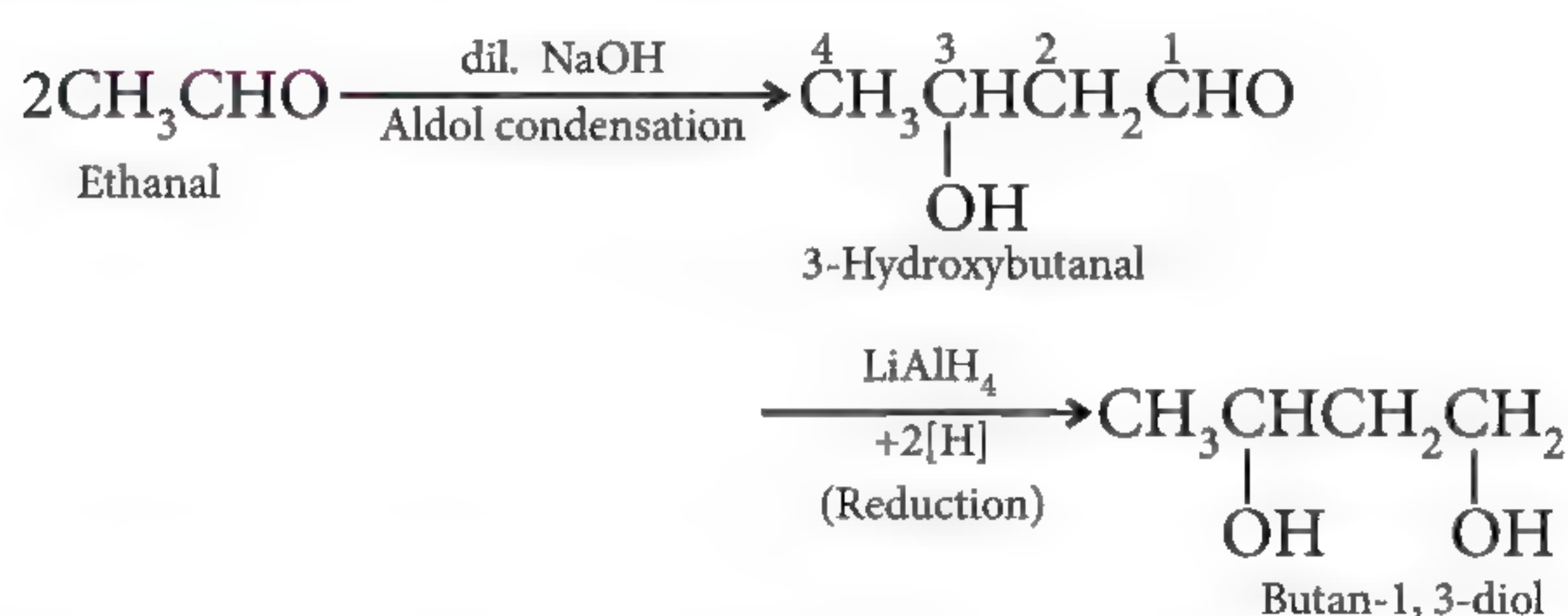
Number of moles of sucrose in 1 litre water = $\frac{68.4}{342} = \frac{1}{5}$

Both urea and sucrose are non-electrolytic solute and have same concentration. Thus, both will have equal lowering of vapour pressure.



33. (b): A catalyst provides an alternate path to the reaction which has lower activation energy.

34. (d): Ethanal to butane-1, 3-diol



35. (d): Half-life period of a first order reaction is independent of the initial concentration.

$$t_{1/2} = \frac{0.693}{k}$$

36. (b): $\text{C}_2\text{H}_5\text{NH}_2 + \text{HONO} \longrightarrow \text{C}_2\text{H}_5\text{OH} + \text{N}_2 + \text{H}_2\text{O}$

37. (a): Zinc passes into solution.

38. (c)

39. (b)

40. (b): Matte mainly consists of Cu_2S with small amount of FeS .

41. (b)

42. (c): Packing efficiency of *bcc* lattice = 68%

Hence, empty space = 32%.

43. (a): $\text{C}_4\text{H}_{10}\text{O} \xrightarrow{\text{excess of HI}}$ only RI

Since, the compound ($\text{C}_4\text{H}_{10}\text{O}$) does not react with sodium, oxygen must be in the form of ether (ROR). Further, since a single alkyl halide is formed, the two alkyl groups must be same, hence ether is $\text{C}_2\text{H}_5\text{OC}_2\text{H}_5$.

44. (c):

Mn^{2+}	Cu^{3+}	Co^{3+}	Co^{2+}
$[\text{Ar}]3d^5$	$[\text{Ar}]3d^8$	$[\text{Ar}]3d^6$	$[\text{Ar}]3d^7$
No pairing of e^-	No pairing of e^-	Pairing of e^-	No pairing of e^-
Paramagnetic	Paramagnetic	Diamagnetic	Paramagnetic

45. (c)

46. (b): 2.5% (mass/volume) NaCl means 2.5 g NaCl in 100 mL of water.

Thus, $\pi = iCRT = \frac{2 \times 2.5 \times 1000 \times 0.082 \times 300}{58.5 \times 100}$

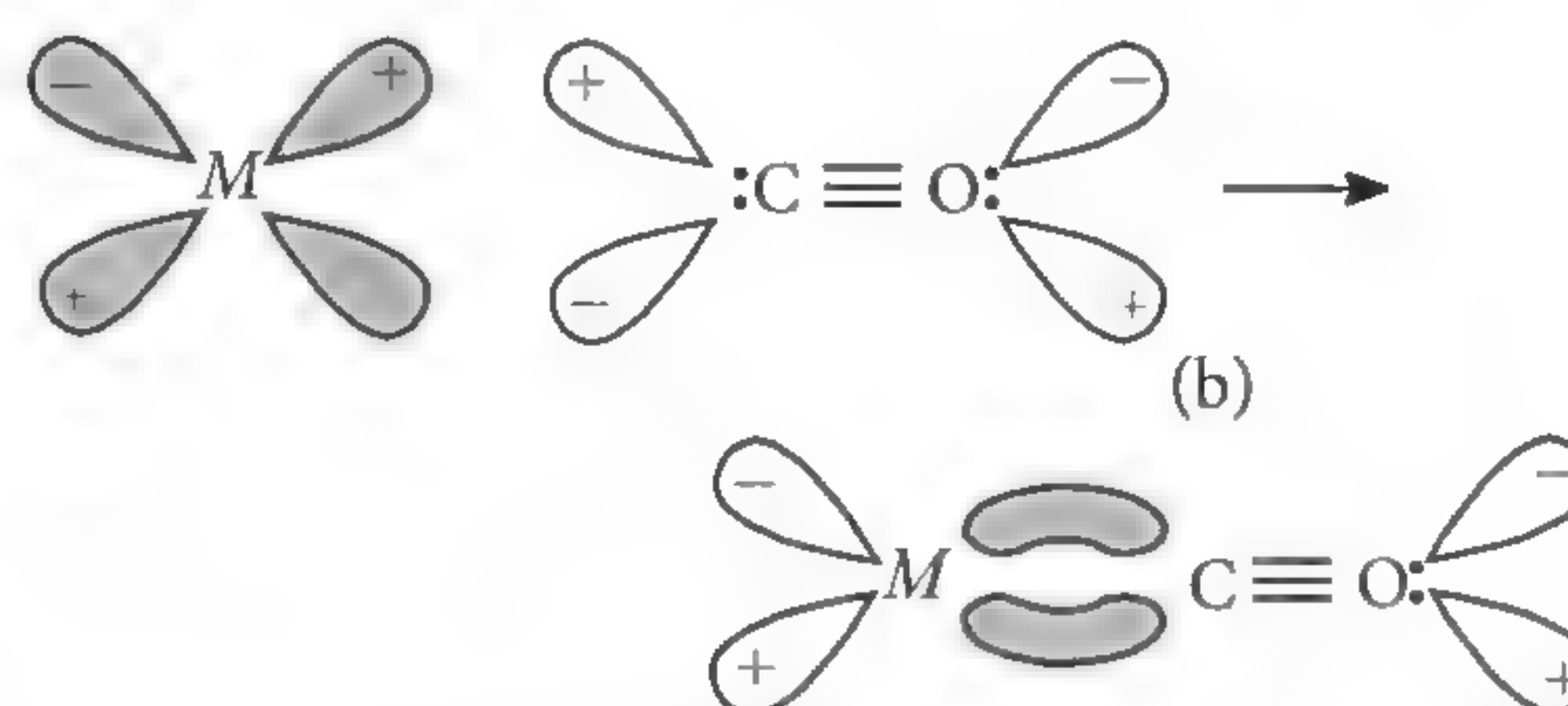
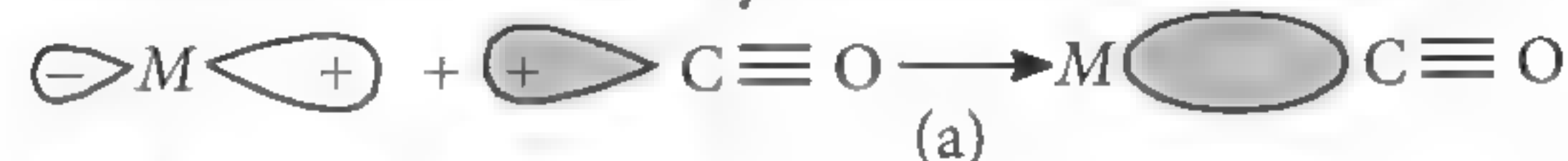
= 21.02 atm

47. (a)

48. (b): Low density polythene is chemically inert.

49. (b): In a metal carbonyl, the metal carbon bond possesses both the σ - and π -character. A σ -bond between metal and carbon atom is formed when a vacant hybrid bond of the metal atom overlaps with an orbital of C atom of carbon monoxide containing a lone pair of electrons.

Formation of π -bond is caused when a filled orbital of the metal atom overlaps with a vacant antibonding π^* orbital of C atom of CO. This overlap is also called back donation of electrons by metal atom to carbon.



(i) The formation of the metal \leftarrow carbon σ -bond using an unshared pair of the C atom. (ii) The formation of the metal \rightarrow carbon π -bond.

50. (b)

MONTHLY TEST DRIVE CLASS XII ANSWER KEY

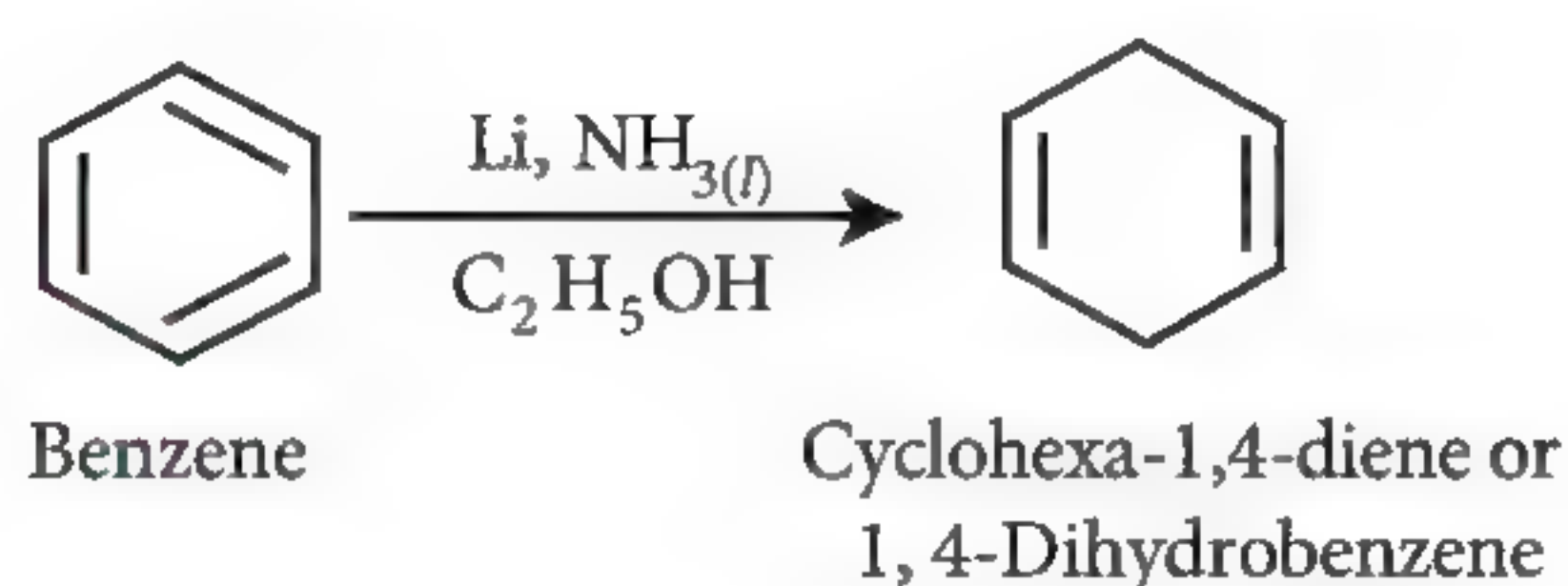
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|---------------|------------|------------|---------|------------|
| 1. (a) | 2. (a) | 3. (b) | 4. (a) | 5. (b) |
| 6. (a) | 7. (c) | 8. (d) | 9. (d) | 10. (c) |
| 11. (c) | 12. (a) | 13. (b) | 14. (a) | 15. (a) |
| 16. (d) | 17. (d) | 18. (b) | 19. (b) | 20. (a, b) |
| 21. (a, b, d) | 22. (a, d) | 23. (b, c) | 24. (5) | 25. (8) |
| 26. (4) | 27. (d) | 28. (a) | 29. (b) | 30. (c) |

ORGANIC CHEMISTRY

SOME REDUCTION REACTIONS

BIRCH REDUCTION REACTION

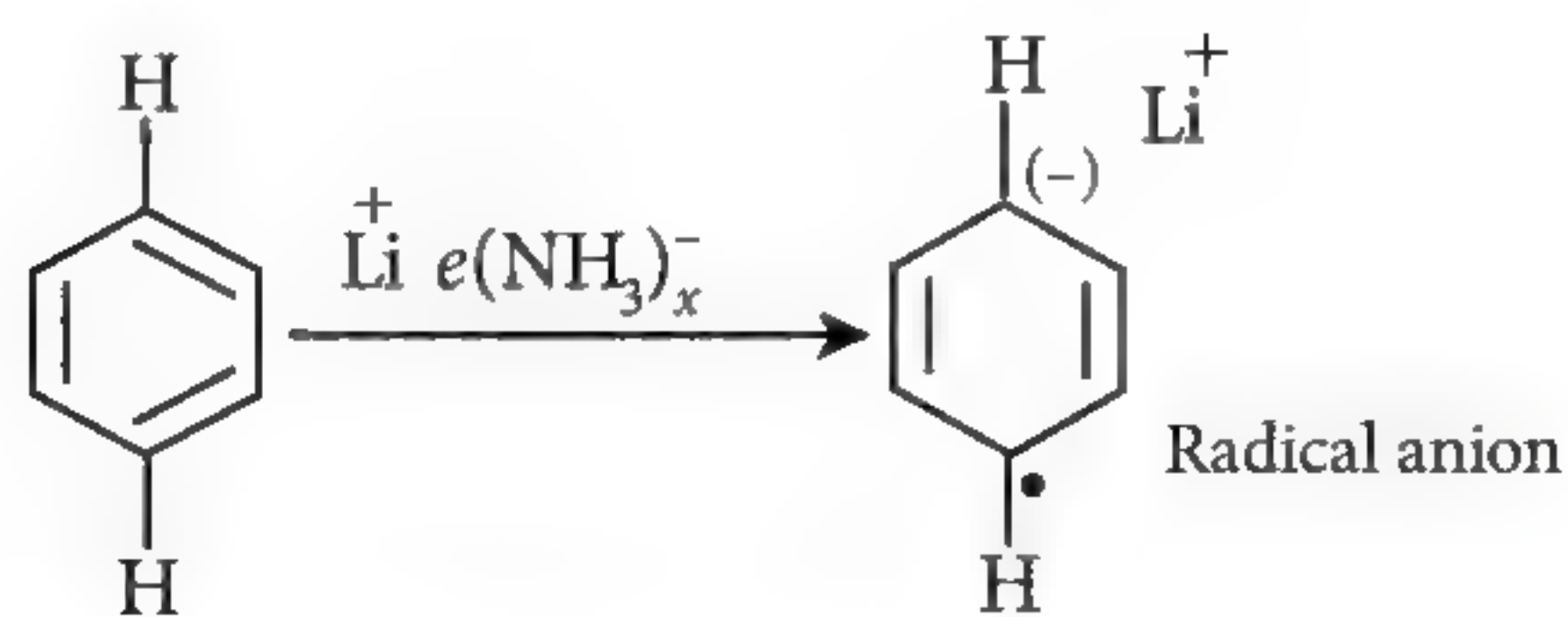
- Reduction of aromatic ring with Na, K or Li metals in liquid NH_3 in the presence of alcohol to give a non-conjugated diene is known as Birch reduction.
- This is incomplete reduction of benzene ring.



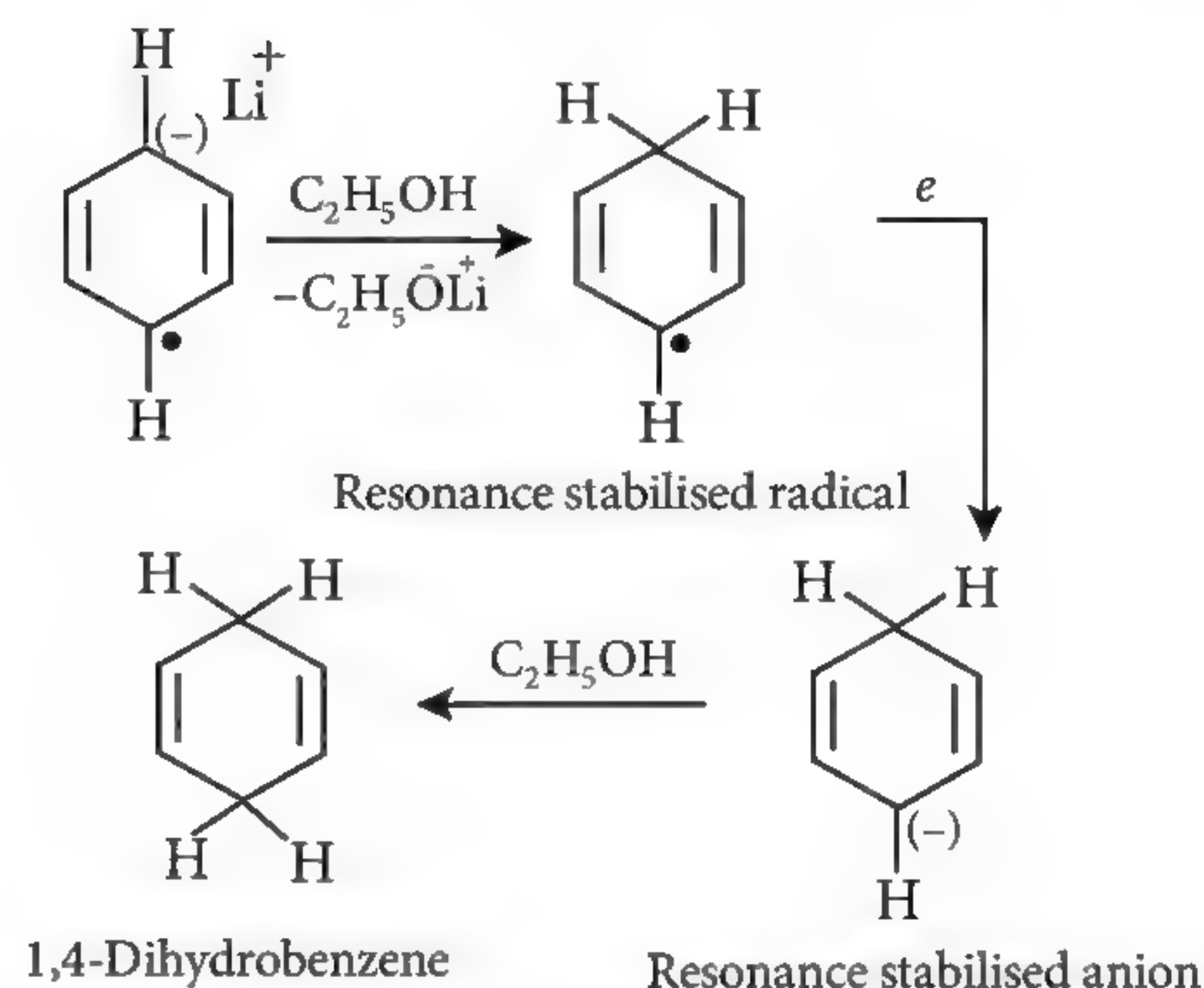
- Birch reduction differs from catalytic reduction in the sense that the ring is not reduced here completely. Whatever it may be, the reduction ends up with destruction of aromaticity.

Mechanism

- Blue solution of Li (or Na) metal in liquid ammonia is used here. Such solutions contain solvated electron, the first electron transfer produces a delocalized benzene radical anion. The resulting species is called radical anion.



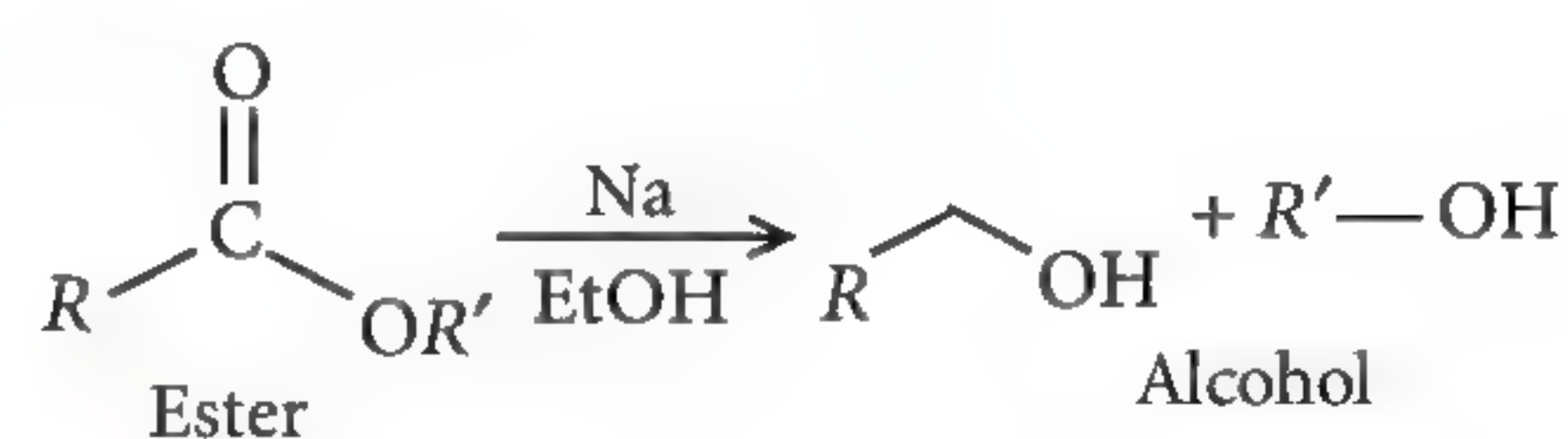
- The radical anion being strongly basic, abstracts a proton from ethanol to give a radical. The radical is then transformed to anion by accepting another electron from the metal. Finally, the anion is quenched by the protic solvent.



- Electron releasing groups such as alkyl or alkoxy groups always wind up on the reduced part of the ring and also accelerate the reaction.
- Electron withdrawing groups such as $-\text{COOH}$ appear on the reduced part of the ring and also slow down the reaction.

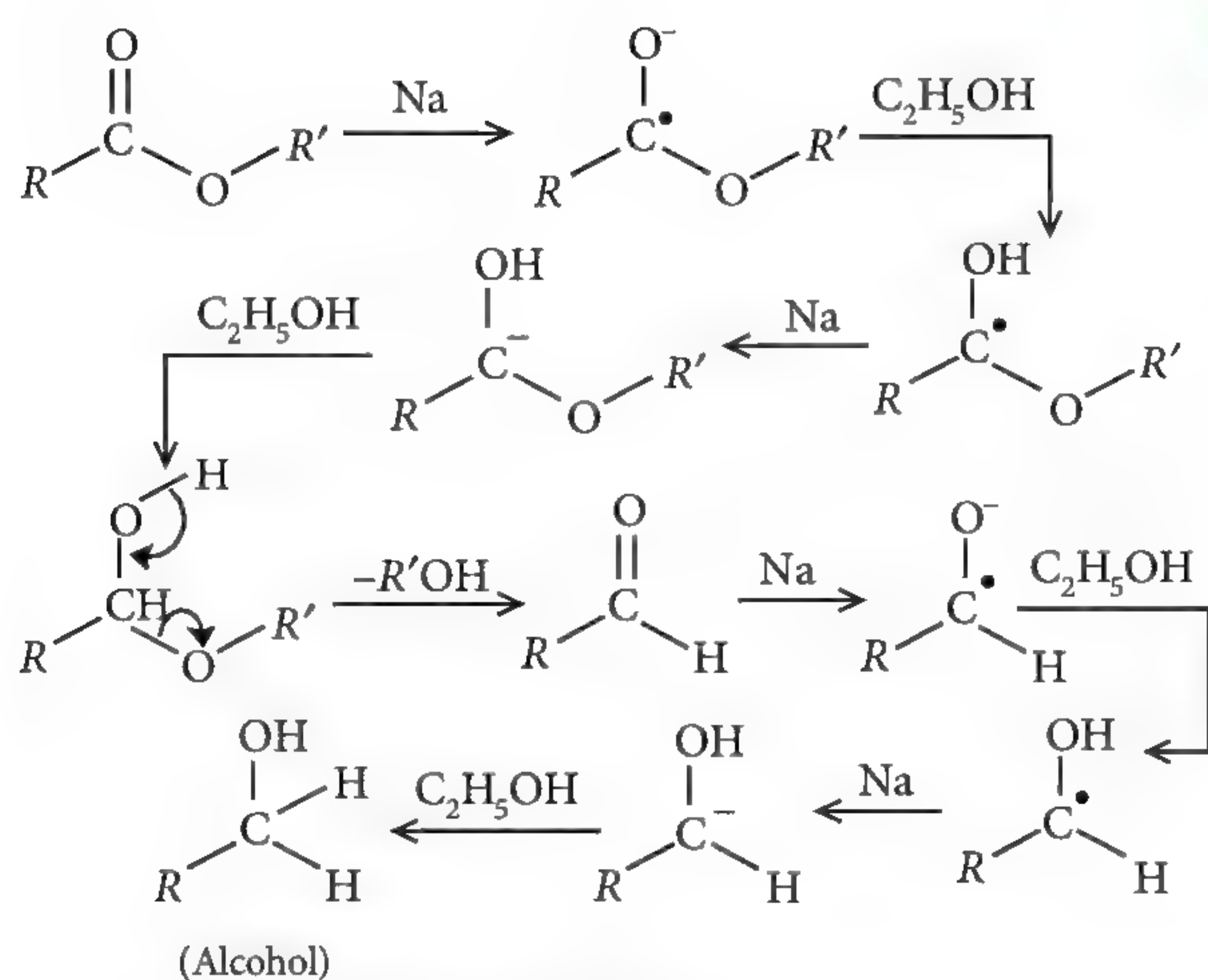
BOUVEAULT – BLANC REDUCTION REACTION

The Bouveault – Blanc reduction is the method of reduction of ester to primary alcohols using absolute ethanol and sodium.



Mechanism

- Sodium has only one electron in its valence shell. It donates its valence electron to the low-lying π^* orbital of $-\text{CO}-$ group. The result is the formation of a radical anion, the first intermediate in the course of the reaction. The ester then moves on to give aldehyde, which is subsequently reduced to alcohol almost in a similar way as the ester was reduced to aldehyde.

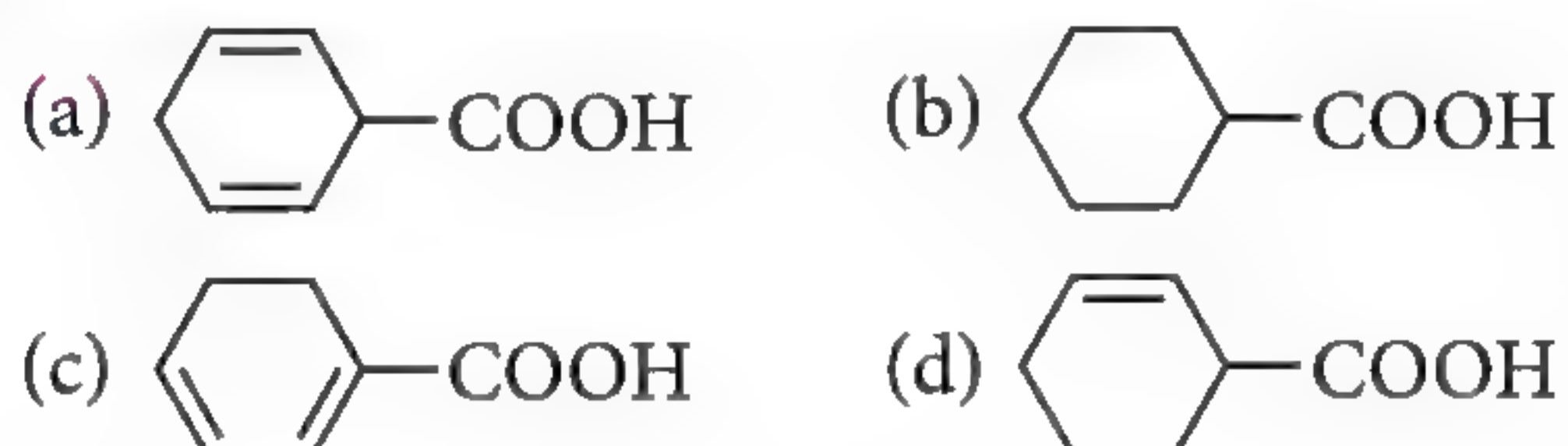


- As we can see from the mechanism, one ester molecule consumed four sodium atoms for reduction to alcohol. In the absence of a proton source, the reduction of ester using Na would give acyloin; the reaction is acyloin condensation.

Questions for Practice

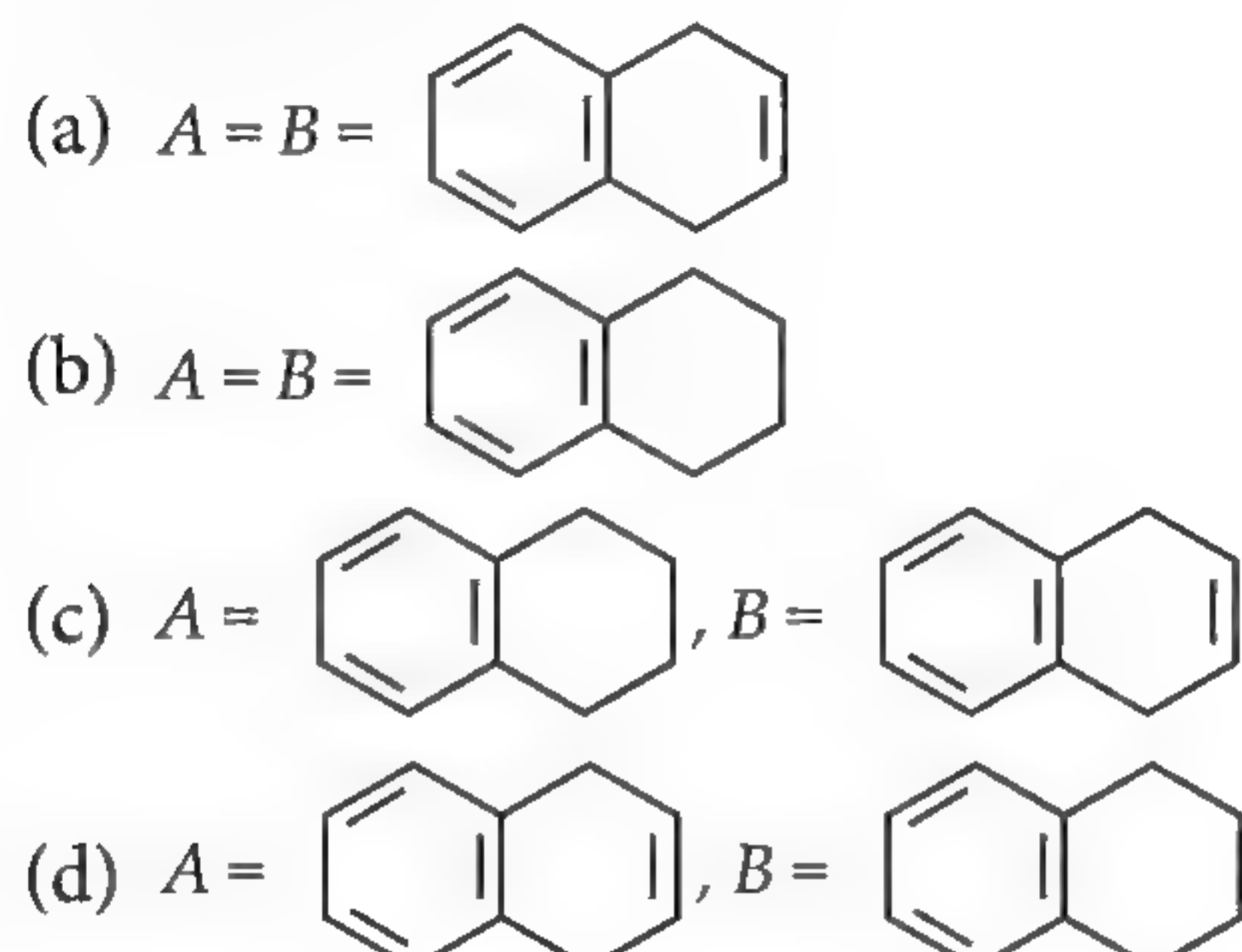
- Bouveault-Blanc reduction involves
 - reduction of an acyl halide with H_2/Pd
 - reduction of an ester with $\text{Na}/\text{C}_2\text{H}_5\text{OH}$
 - reduction of a carbonyl compound with Na/Hg and HCl
 - reduction of an anhydride with LiAlH_4 .

- Birch reduction of benzoic acid gives



- 'A' $\xleftarrow[\text{C}_5\text{H}_{11}\text{OH}]{\text{Na, in boiling}}$ $\xrightarrow[\text{C}_2\text{H}_5\text{OH}]{\text{Na, in boiling}}$ 'B'

'A' and 'B' are

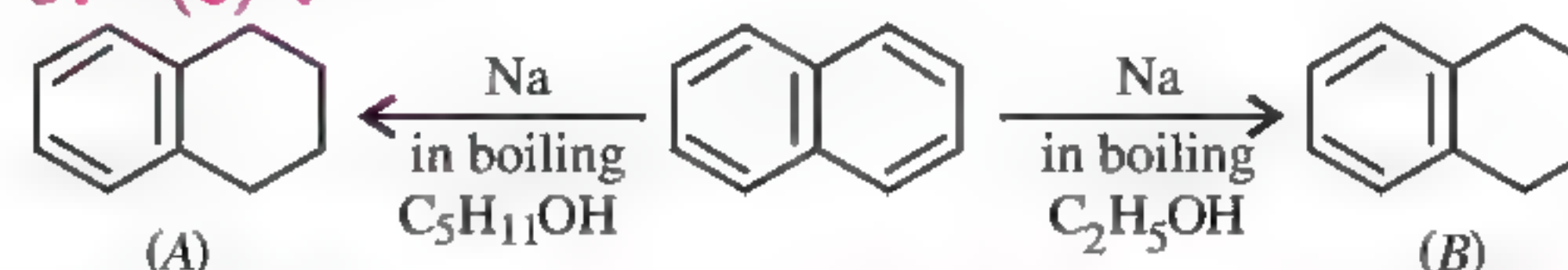


SOLUTIONS

1. (b) : Bouveault-Blanc reduction reaction involves reduction of an ester with $\text{Na}/\text{C}_2\text{H}_5\text{OH}$.

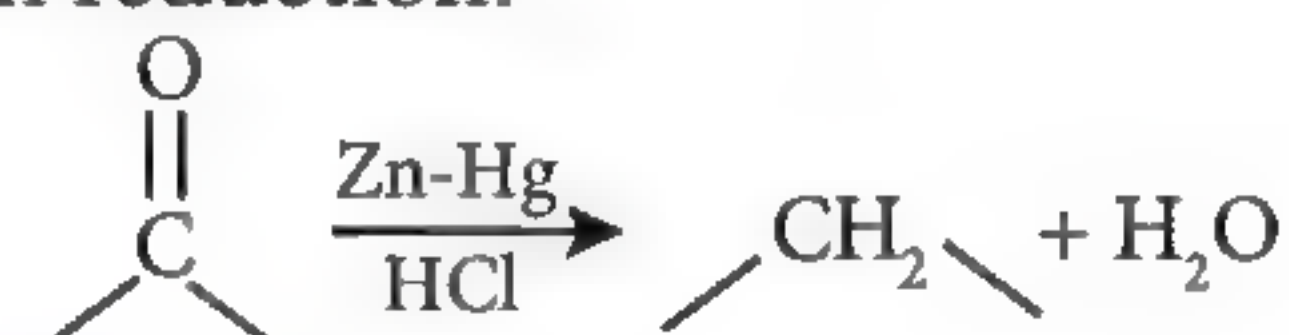
2. (a) : Birch reduction of benzoic acid gives product given in option (a).

3. (c) :



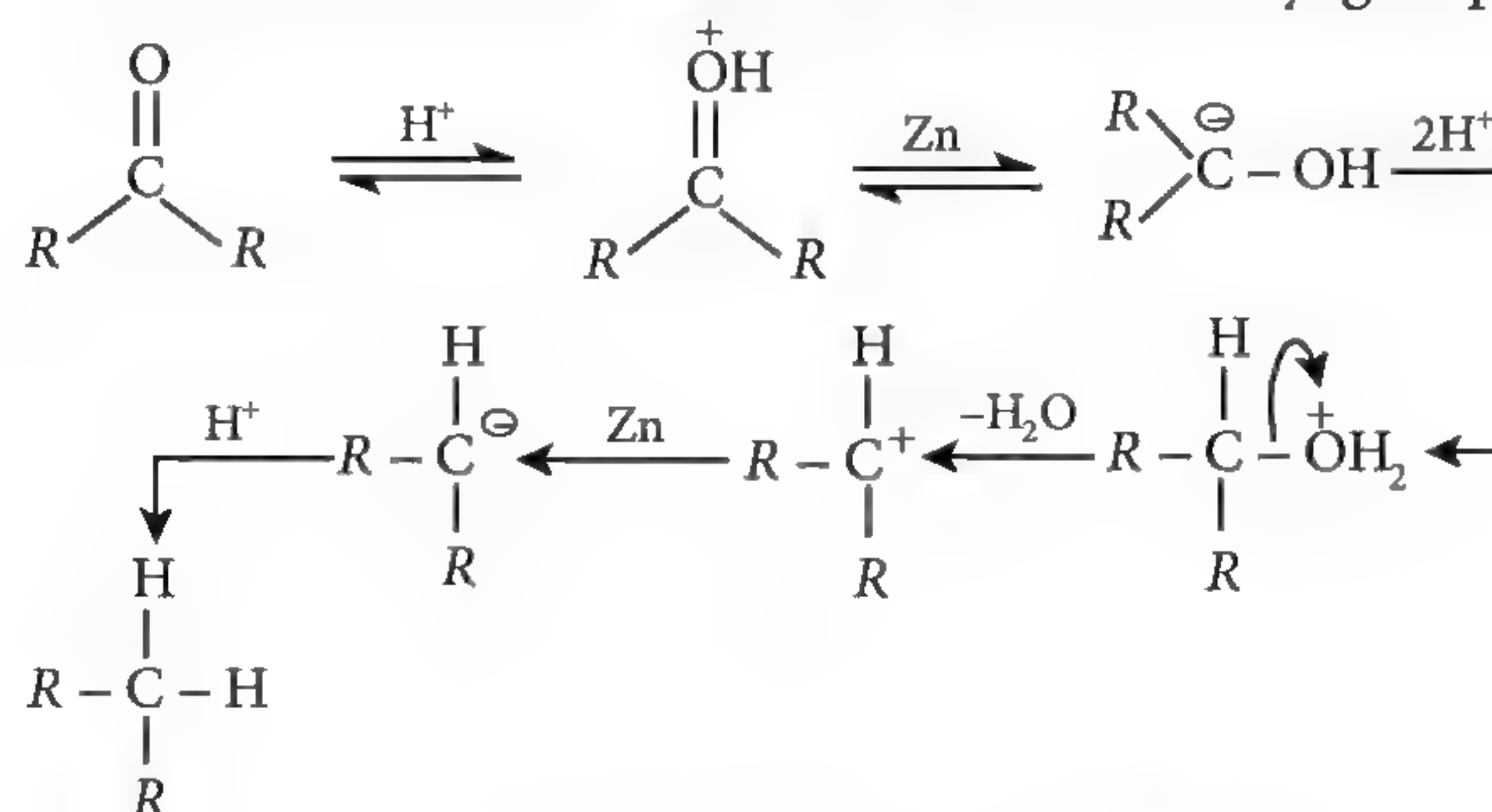
CLEMMENSEN REDUCTION REACTION

The reduction or removal of carbonyl group of aldehydes or ketones using finely divided amalgamated Zn in presence of mineral acid, HCl is known as Clemmensen reduction.



Mechanism

- Zinc provides a clean active surface. The zinc metal dissolves in acid and gives up two electrons. These two electrons are used to reduce the carbonyl group.



WOLFF-KISHNER REDUCTION REACTION

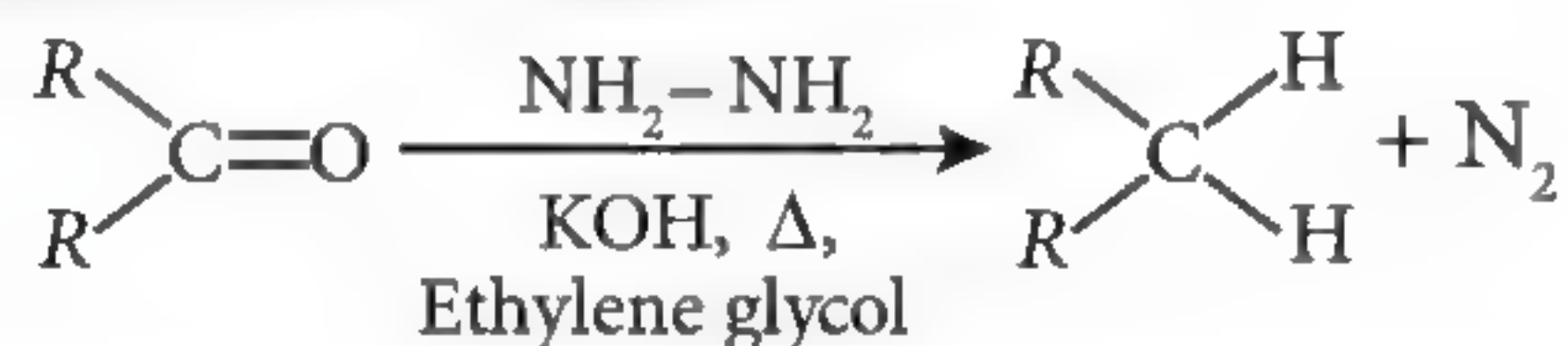
- The carbonyl group of aldehydes and ketones is reduced to $>\text{CH}_2$ group on treatment with hydrazine followed by heating with sodium or

COMIC CAPSULE

What did the thermometer say to the measuring cylinder?

"You may be graduated, but I have several degrees."

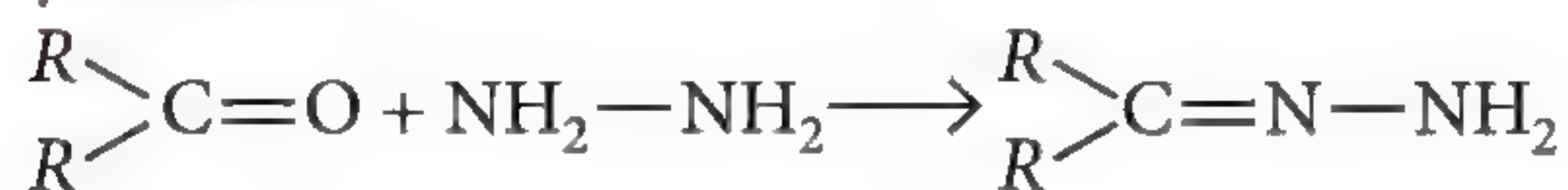
potassium hydroxide in high boiling solvent such as ethylene glycol. This reaction is called Wolff-Kishner reduction, named so to honour N. Kishner and L. Wolff.



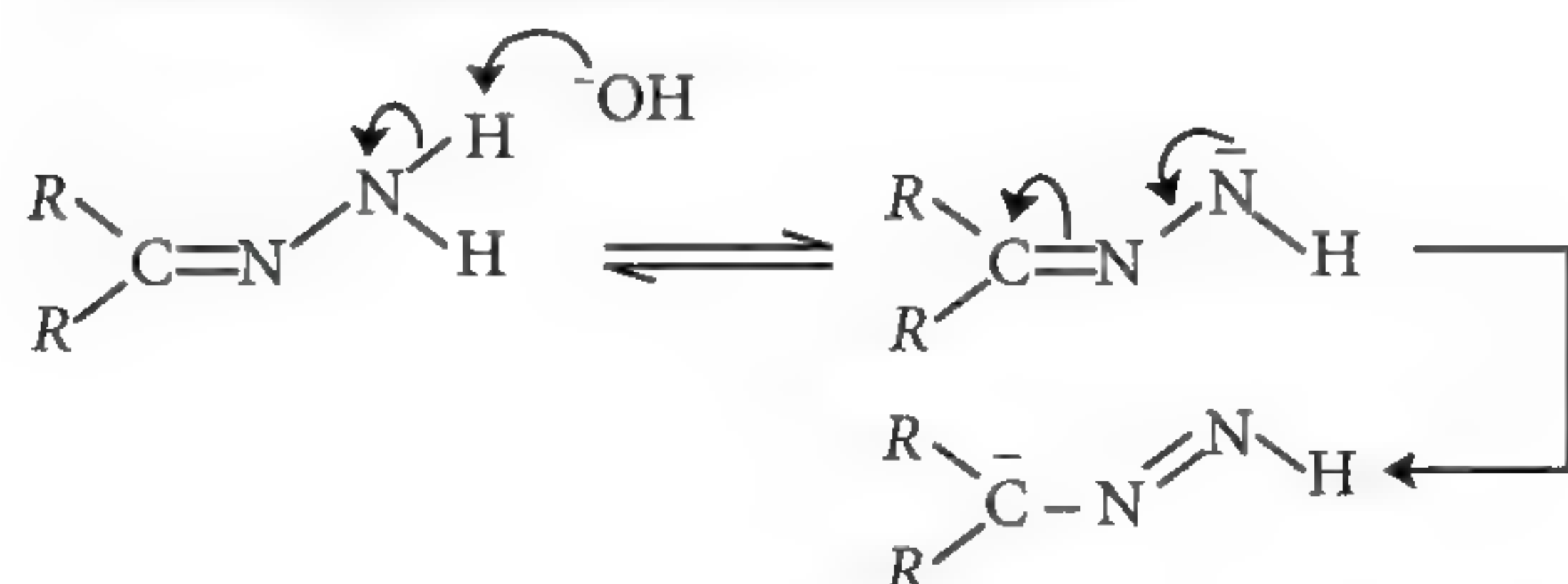
This reaction is used in organic chemistry to convert carbonyl functionalities into methylene groups.

Mechanism

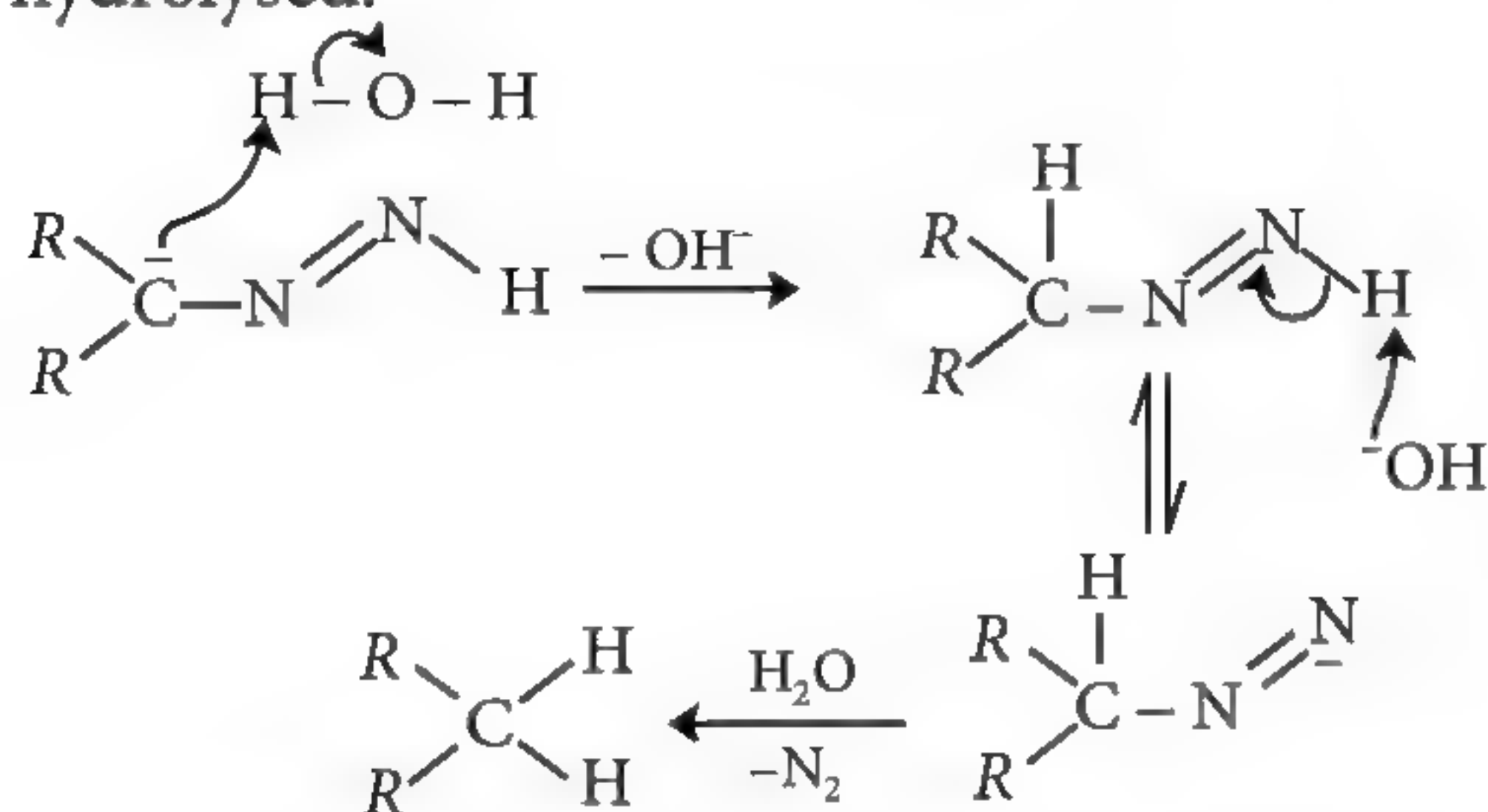
- Attack of hydrazine on carbonyl group to form hydrazone.



- The hydrazone is first deprotonated to give a resonance stabilised intermediate.

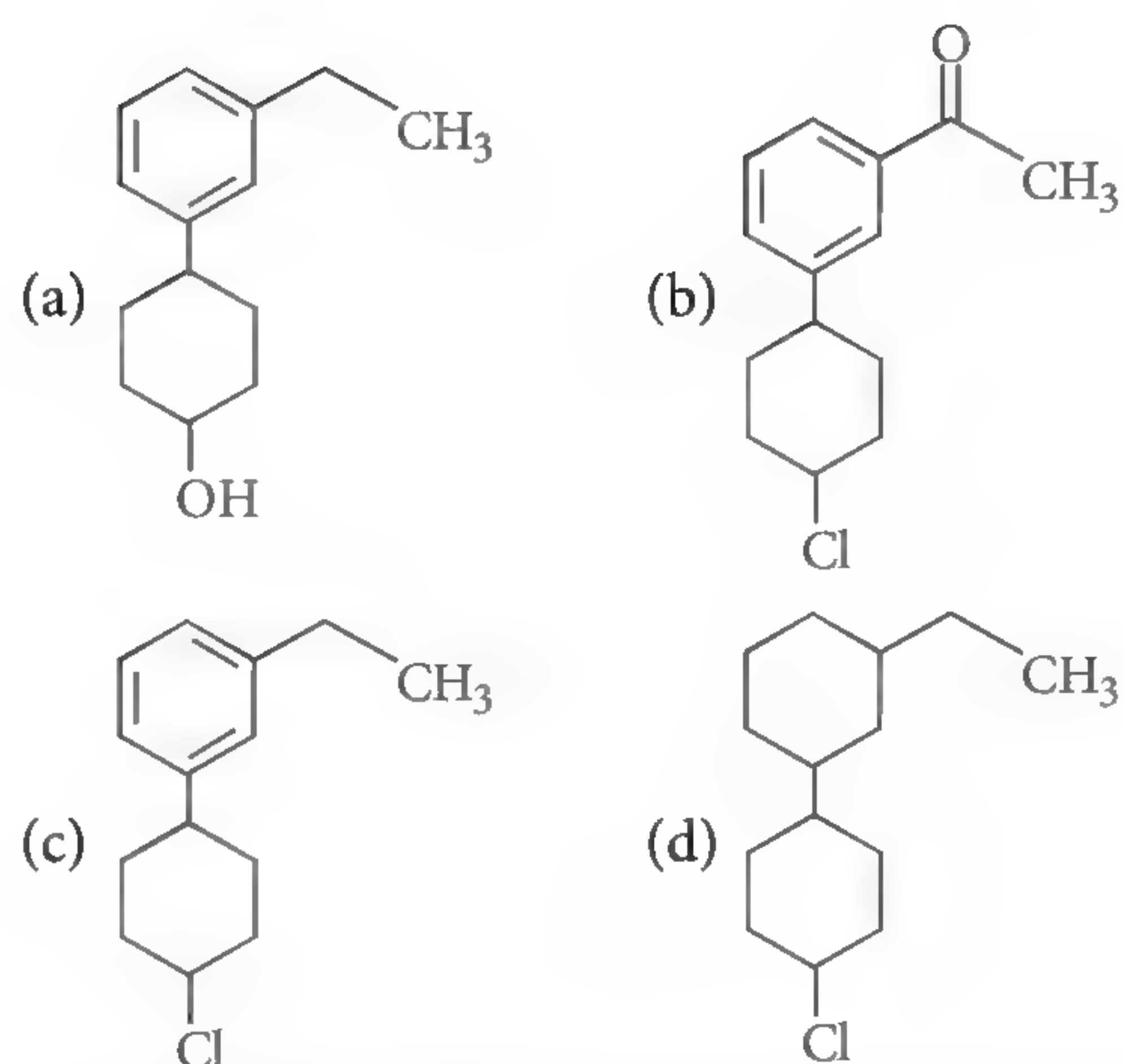
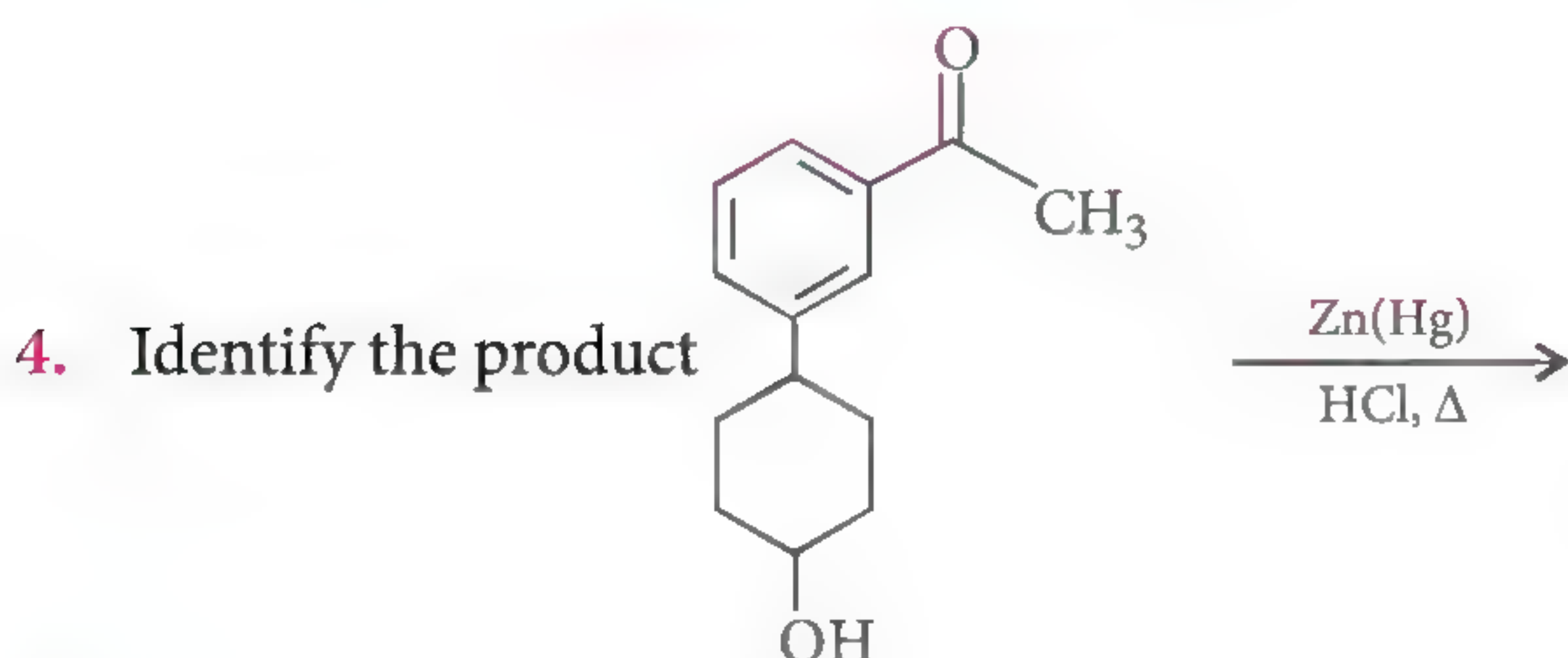


- Finally, the anionic intermediate is protonated and deprotonated to generate a species that has a nitrogen leaving group, which is subsequently hydrolysed.

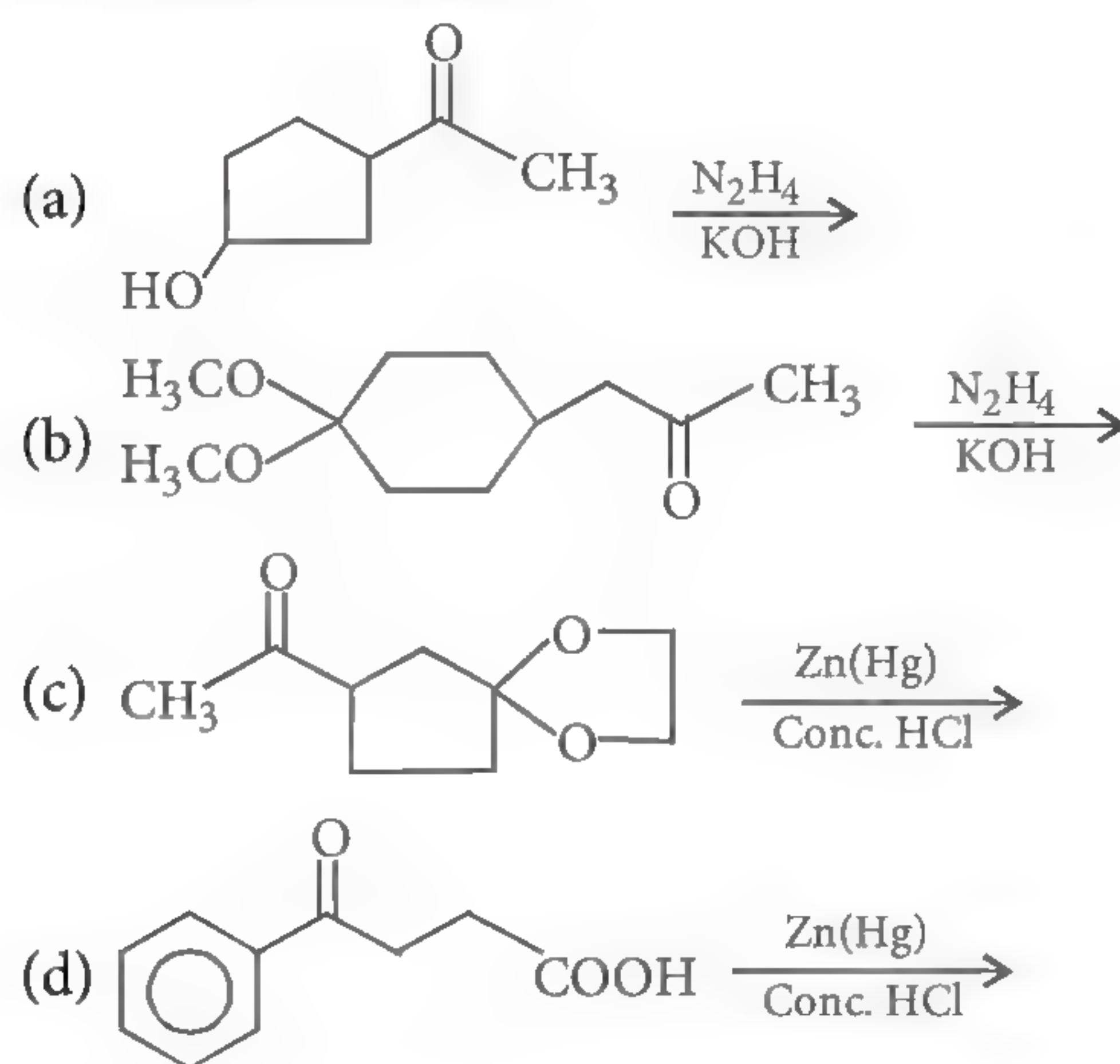


- Wolff-Kishner reduction has been used to synthesise aromatic hydrocarbons with long straight chain alkyl group. This is achieved through acylation.

Questions for Practice



5. Which of the following would give a hydrocarbon as a reduced product?



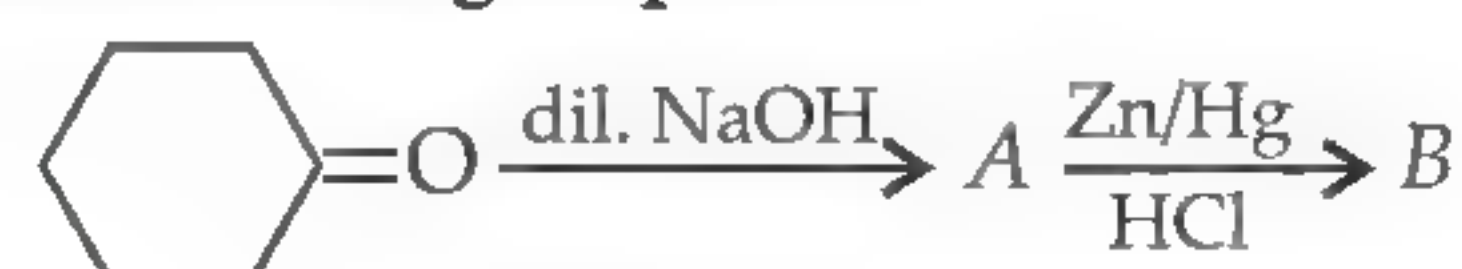
6. $\begin{array}{c} R \\ \diagup \\ C=O \\ \diagdown \\ R \end{array}$ is not converted to $\begin{array}{c} R \\ \diagup \\ CH_2 \\ \diagdown \\ R \end{array}$ by

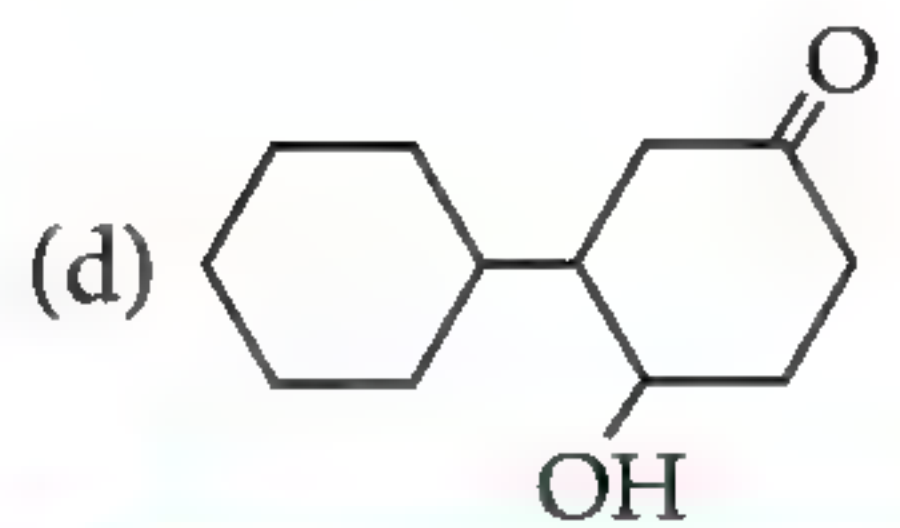
- (a) Wolff-Kishner reaction
(b) Clemmensen reduction
(c) Red P + HI at 200°C
(d) Wurtz reaction.

7. Which one of the following pairs is not correctly matched?

- (a) $\begin{array}{c} >C=O \end{array} \xrightarrow{\text{Clemmensen reduction}} \begin{array}{c} >CH_2 \end{array}$
(b) $\begin{array}{c} >C=O \end{array} \xrightarrow{\text{Wolff Kishner reduction}} \begin{array}{c} >CHOH \end{array}$
(c) $-\text{COCl} \xrightarrow{\text{Rosenmund's reduction}} \text{CHO}$
(d) $-\text{C}\equiv\text{N} \xrightarrow{\text{Stephen reduction}} \text{CHO}$

8. B in the following sequence is





6. (d) : In Wurtz reaction two molecules of alkyl

8. (b) :

The reaction scheme shows the synthesis of 1,2-cyclohexylcyclohexanol (B) from cyclohexanone and cyclohexanecarbaldehyde. The starting materials are cyclohexanone and cyclohexanecarbaldehyde, which react in the presence of dilute NaOH to form an intermediate β -hydroxy ketone (A), 1-(cyclohexyl(cyclohexylamino))cyclohexan-1-ol. This intermediate is then reduced using Zn/Hg and HCl to yield the final product, 1,2-cyclohexylcyclohexanol (B).

(B)

(A)

OLYMPIAD PROBLEMS



- If 500 mL of 0.4 M AgNO_3 is mixed with 500 mL of 2 M NH_3 solution then what is the concentration of $[\text{Ag}(\text{NH}_3)]^+$ in solution?
(Given: $K_{f1}[\text{Ag}(\text{NH}_3)]^+ = 10^3$; $K_{f2}[\text{Ag}(\text{NH}_3)_2]^+ = 10^4$)
(a) 3.33×10^{-7} M (b) 3.33×10^{-5} M
(c) 3.0×10^{-4} M (d) 2×10^{-7} M
- 5% of a reaction is completed in 1 hr, 10% in 2 hr and 15% in 3 hr. The order of reaction is
(a) 0 (b) 1 (c) 2 (d) 3
- For a diatomic ideal gas in a closed system, which of the following plots does not correctly describe the relation between various thermodynamic quantities?

(a) C_v vs V

(b) U vs T

(c) C_p vs P

(d) C_v vs T
- Two solids dissociate as follows
 $A_{(s)} \rightleftharpoons B_{(g)} + C_{(g)}; K_{p1} = x \text{ atm}^2$
 $D_{(s)} \rightleftharpoons C_{(g)} + E_{(g)}; K_{p2} = y \text{ atm}^2$
 The total pressure when both the solids dissociate simultaneously is
 (a) $\sqrt{x+y} \text{ atm}$ (b) $x^2 + y^2 \text{ atm}$
 (c) $2(\sqrt{x+y}) \text{ atm}$ (d) $(x+y) \text{ atm}$
- What is the value of average bond order of P — O bond in PO_4^{3-} ?
(a) 1.0 (b) 1.25 (c) 1.50 (d) 1.75
- The element that shows greater ability to form $p\pi-p\pi$ multiple bonds is
(a) C (b) Ge (c) Sn (d) Si
- What is the work function of the metal if the light of wavelength 4000 Å generates photoelectrons of velocity $6 \times 10^5 \text{ m s}^{-1}$ from it?
(Mass of electron = $9 \times 10^{-31} \text{ kg}$, Velocity of light = $3 \times 10^8 \text{ m s}^{-1}$, Planck's constant = $6.626 \times 10^{-34} \text{ J s}$, charge on electron = $1.6 \times 10^{-19} \text{ J eV}^{-1}$)
(a) 4.0 eV (b) 2.1 eV
(c) 0.9 eV (d) 3.1 eV
- The value of Δ_o for $[\text{Rh}(\text{Cl})_6]^{3-}$ is 243 kJ mol $^{-1}$. What wavelength of light will promote an electron from the t_{2g} set to e_g set?
(a) 483 nm (b) 492 nm
(c) 122 nm (d) 729 nm
- Which of the following is not expected to form intramolecular hydrogen bond?

(a)

(b)

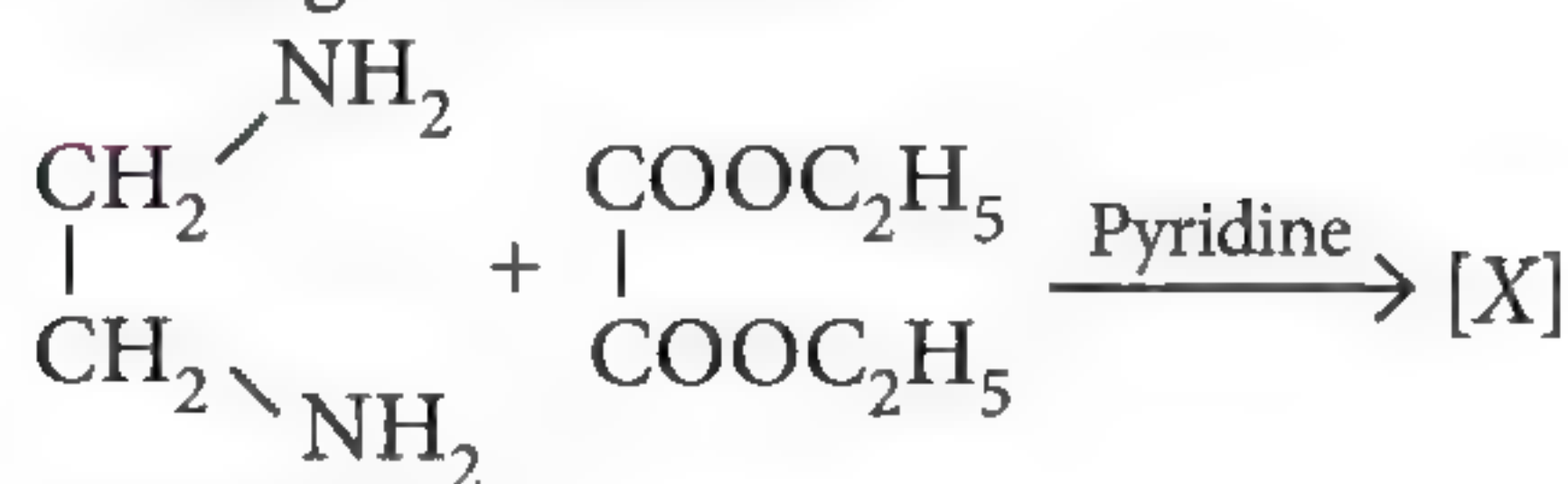
(c)

(d)
- $$G-\text{C}_6\text{H}_4-\text{C}(=\text{O})\text{NH}_2 \xrightarrow{-\text{OBr}^-} G-\text{C}_6\text{H}_4-\text{NH}_2$$

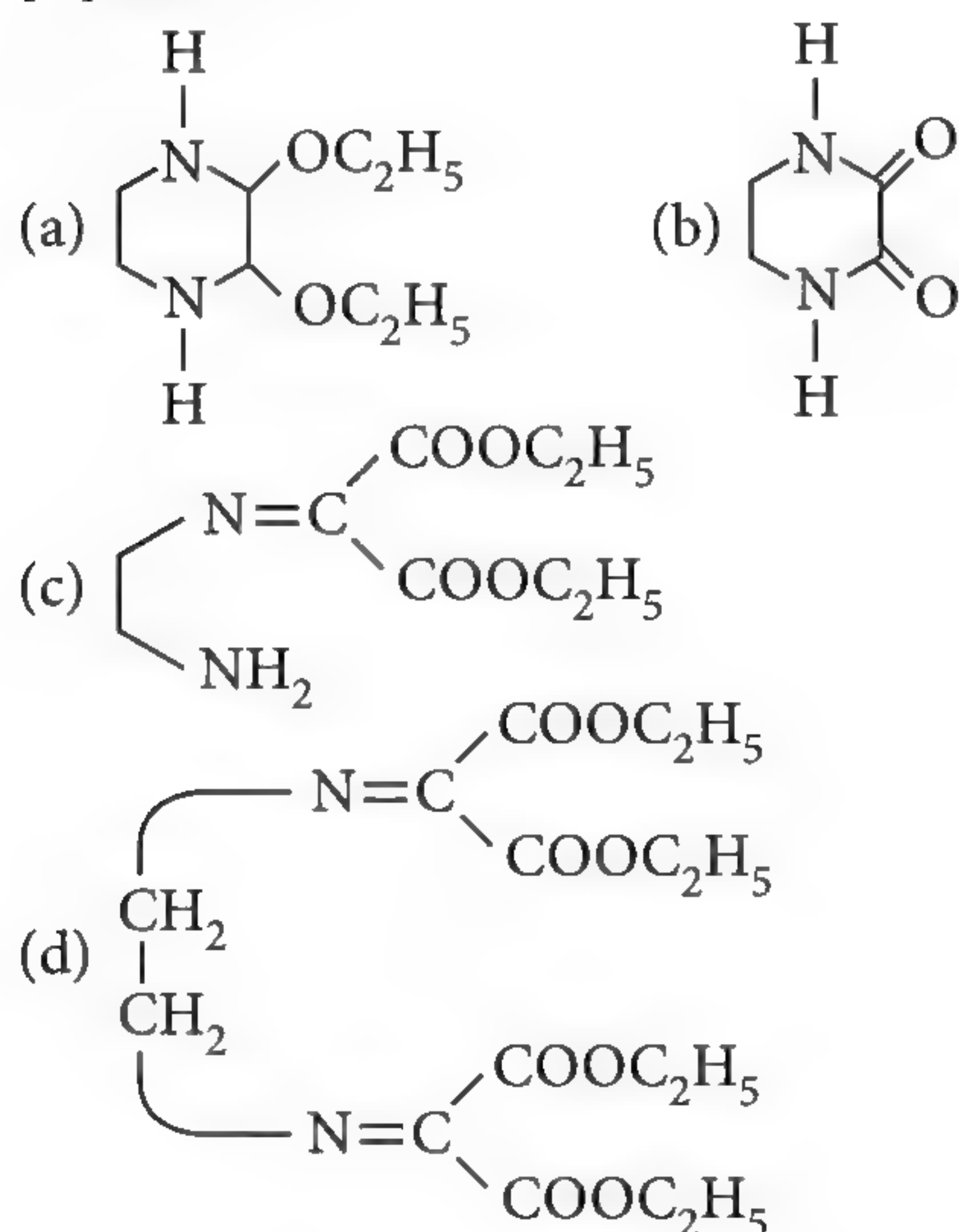
The rate of Hoffmann degradation is influenced by the nature of substituent G. Which of the following represent the correct decreasing rate of degradation with various substituents?

(a) $-\text{NO}_2 > -\text{Cl} > -\text{H} > -\text{CH}_3 > -\text{OCH}_3$
 (b) $-\text{OCH}_3 > -\text{CH}_3 > -\text{Cl} > -\text{H} > -\text{NO}_2$
 (c) $-\text{OCH}_3 > -\text{CH}_3 > -\text{H} > -\text{Cl} > -\text{NO}_2$
 (d) $-\text{CH}_3 > -\text{Cl} > -\text{H} > -\text{OCH}_3 > -\text{NO}_2$

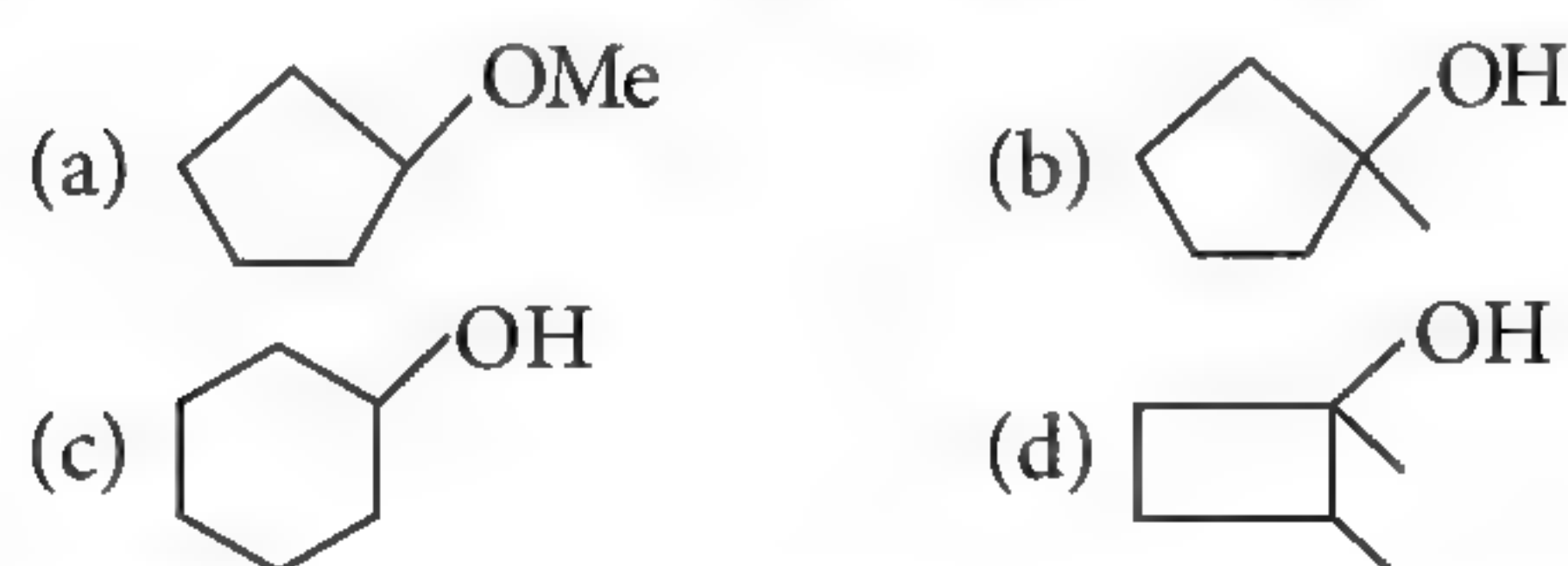
11. In the given reaction :



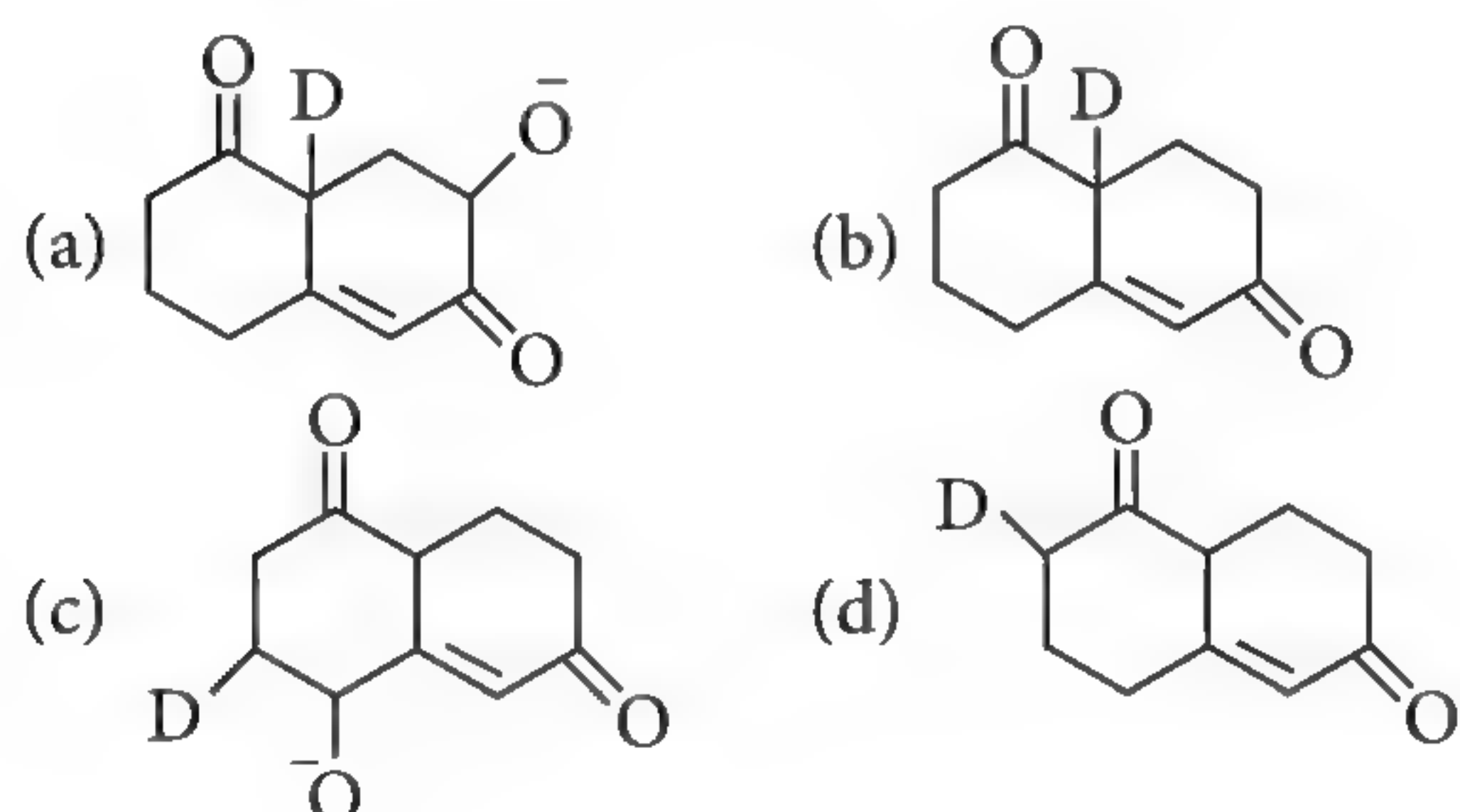
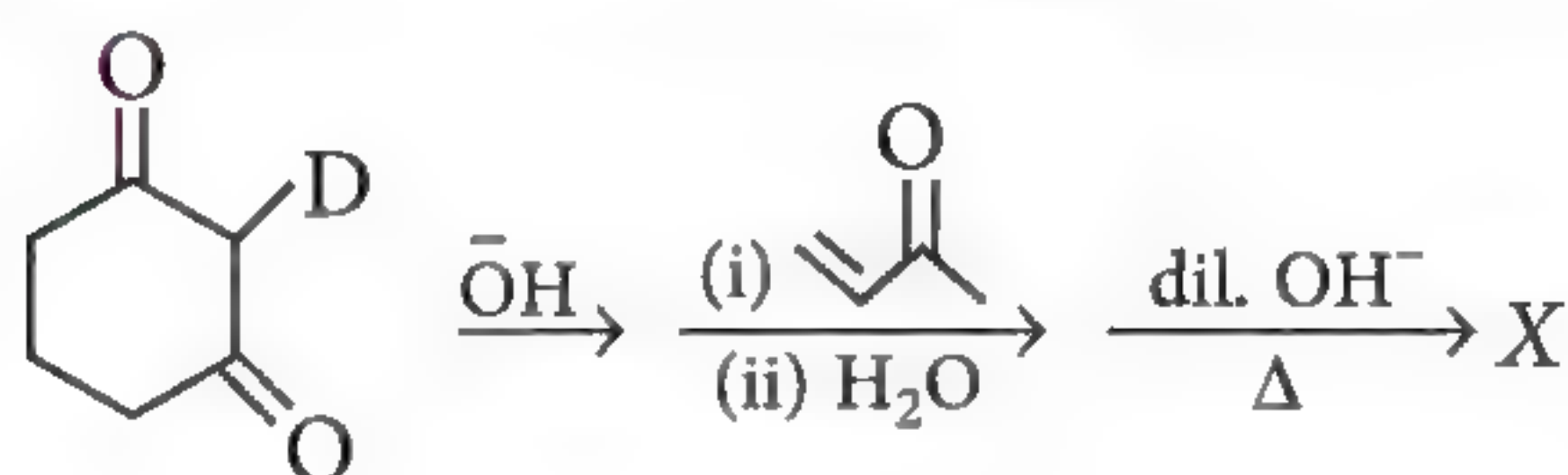
[X] will be



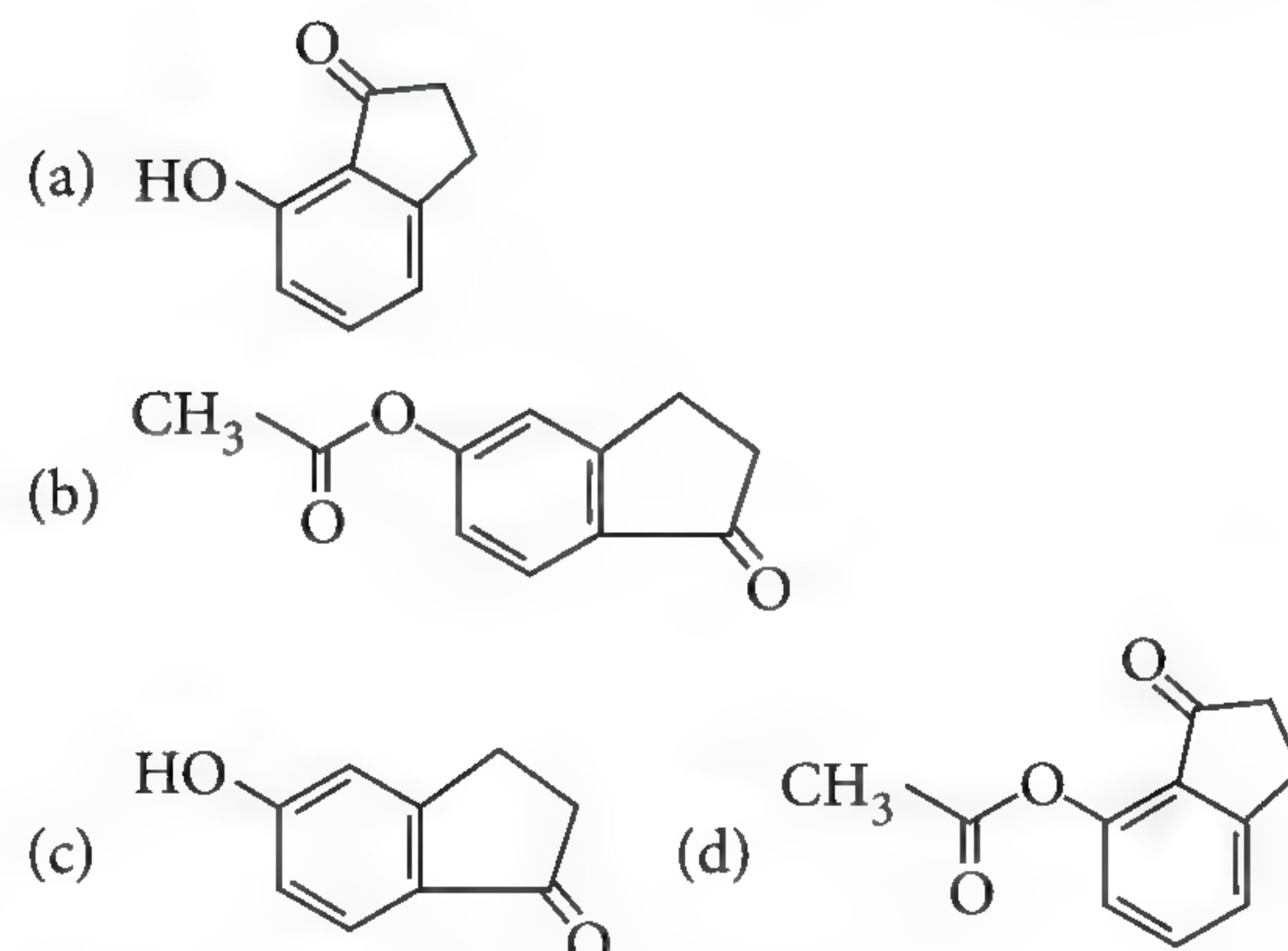
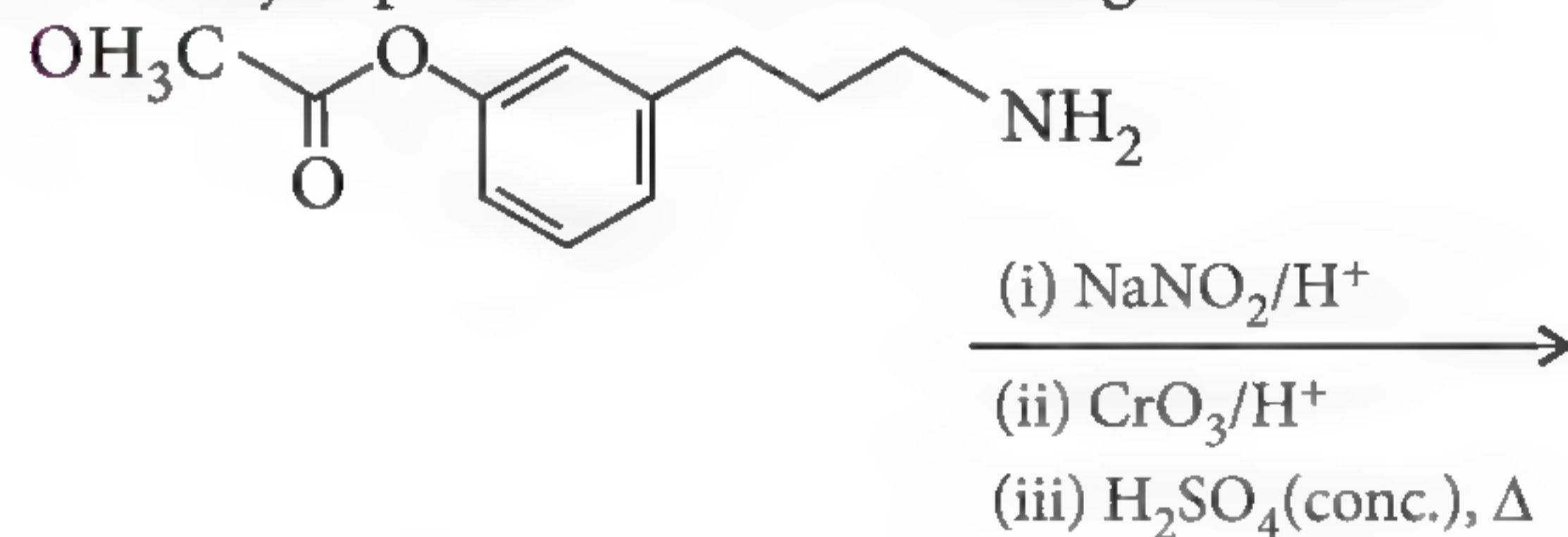
12. An organic compound A ($\text{C}_6\text{H}_{12}\text{O}$) neither decolourises bromine water nor changes the colour of acidic dichromate solution. A on heating with H_2SO_4 produces an alkene which on oxidative ozonolysis gives $\text{B}(\text{C}_6\text{H}_{10}\text{O}_3)$, which gives a yellow precipitate with NaOH/I_2 . The most probable structure of A is



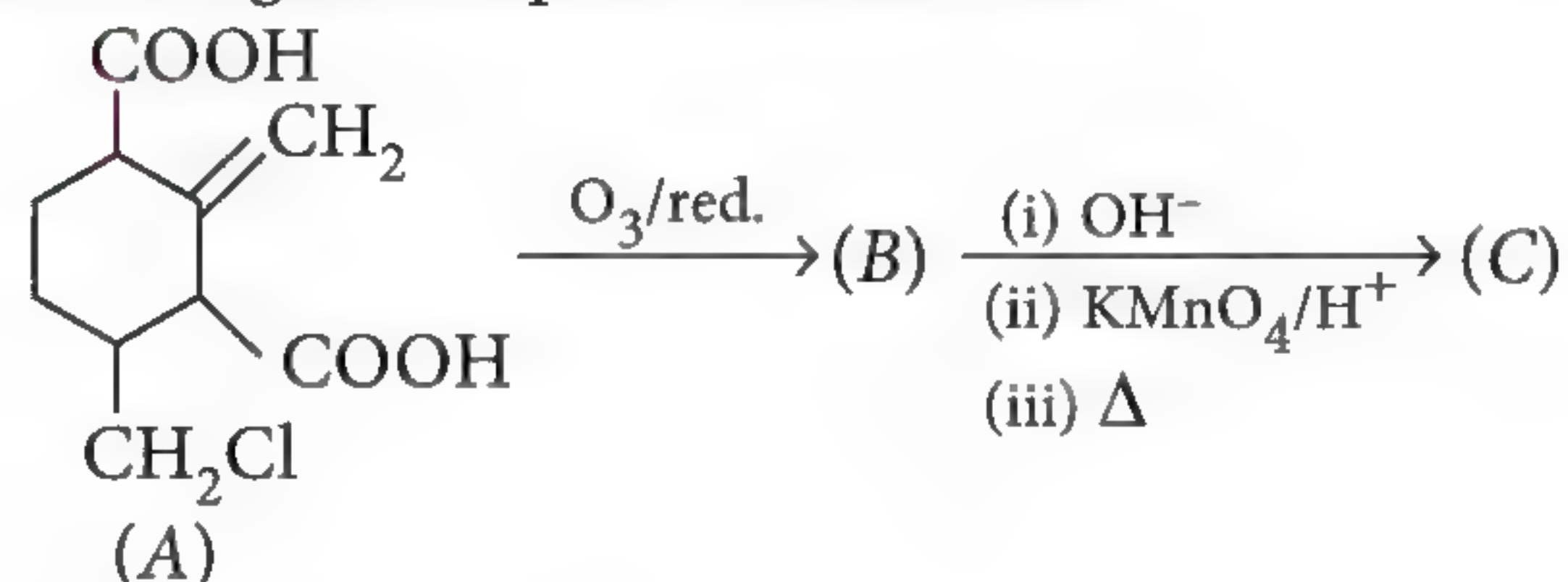
13. Identify X in the following sequence of reactions.



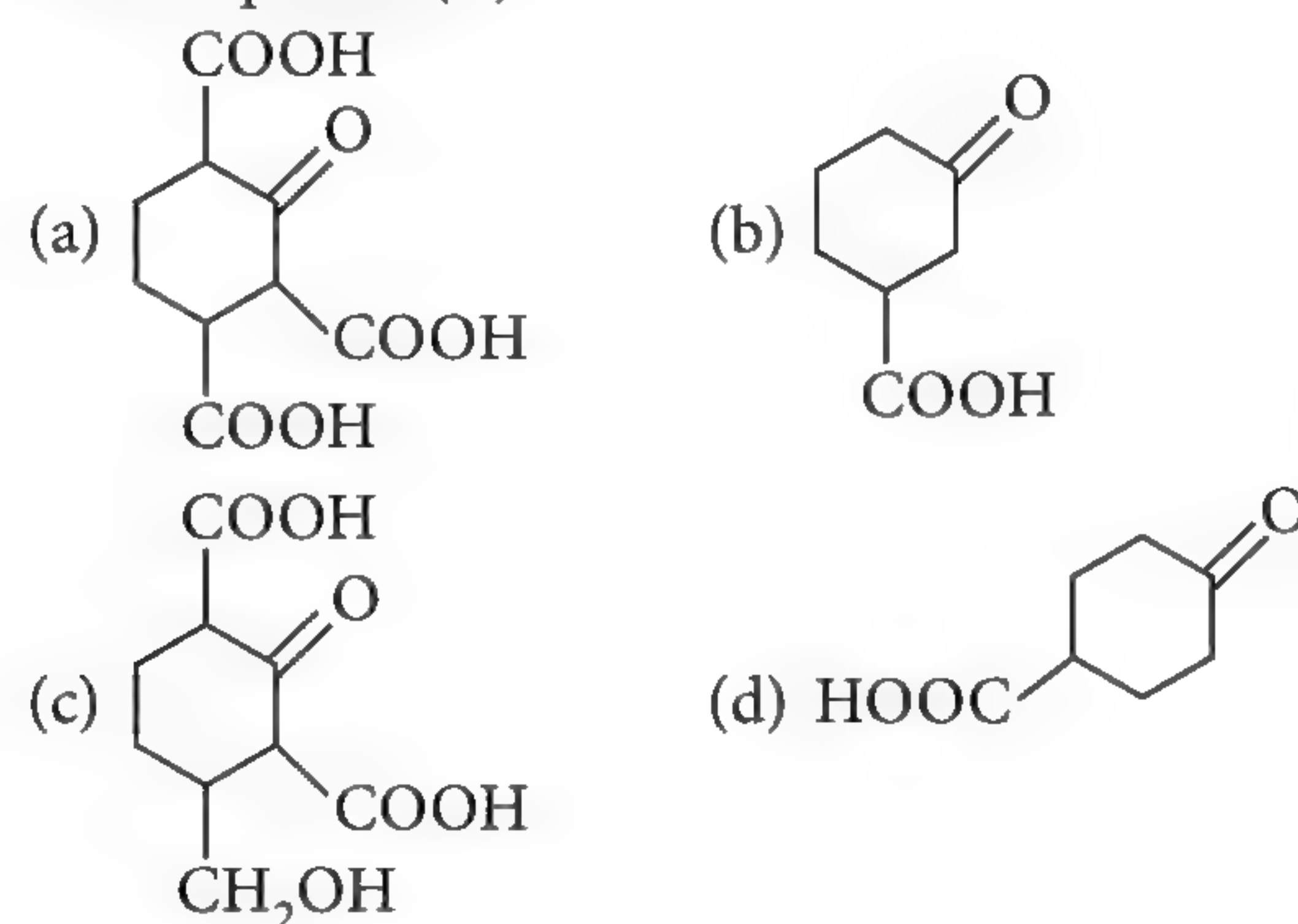
14. The major product of the following reaction is



15. In the given sequence of reactions,



the compound (C) is



16. Select the correct statement.

- The order of Xe-F bond length in various fluorides of xenon is $\text{XeF}_2 < \text{XeF}_4 < \text{XeF}_6$.
- PH_5 can undergo sp^3d hybridisation to have octahedral geometry.
- Dipole moment of CH_3F is greater than that of CH_3Cl .
- Increasing strength of hydrogen bonding is $\text{Cl}-\text{H} \cdots \text{Cl} < \text{N}-\text{H} \cdots \text{N} < \text{O}-\text{H} \cdots \text{O} < \text{F}-\text{H} \cdots \text{F}$

17. Which of the following pairs can be distinguished by the action of heat?

- I. Na_2CO_3 and CaCO_3
 II. $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$ and $\text{CaCl}_2 \cdot 6\text{H}_2\text{O}$
 III. $\text{Ca}(\text{NO}_3)_2$ and NaNO_3
 (a) I and II (b) I, II and III
 (c) I and III (d) I only

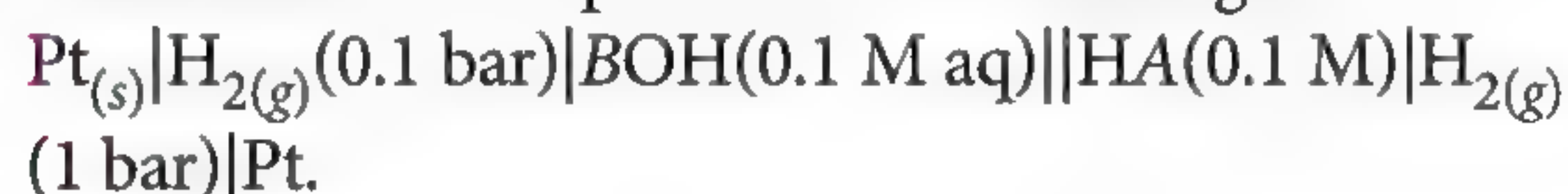
18. Among the lanthanoides some show bivalent character inspite that their group valence is 3. The most stable bivalent lanthanoid among them is

- (a) ${}_{64}\text{Gd}$ (b) ${}_{63}\text{Eu}$ (c) ${}_{60}\text{Nd}$ (d) ${}_{62}\text{Sm}$

19. The magnetic moment of an octahedral homoleptic $\text{Mn}(\text{II})$ complex is 5.9 B.M. The suitable ligand for this complex is

- (a) NCS^- (b) CN^-
 (c) CO (d) ethylenediamine

20. Calculate the cell potential of following cell :



Given : $K_a(\text{HA}) = 10^{-7}$, $K_b(\text{BOH}) = 10^{-5}$

- (a) 0.38 V (b) 0.45 V (c) 0.93 V (d) 0.63 V

21. Given :

Gas	H_2	CH_4	CO_2	SO_2
Critical Temperature/K	33	190	304	630

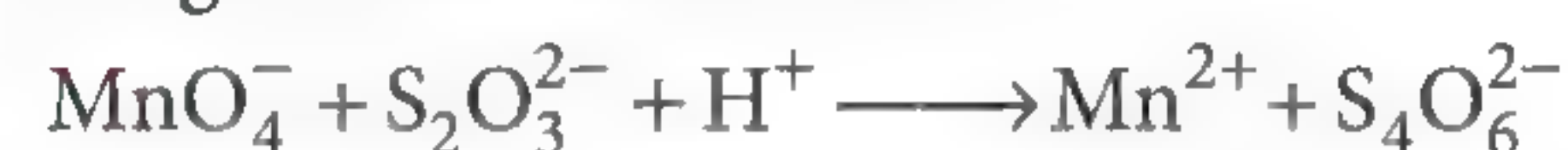
On the basis of data given above, predict which of the following gases shows least adsorption on a definite amount of charcoal?

- (a) H_2 (b) CH_4 (c) CO_2 (d) SO_2

22. The value of compressibility factor Z of a gas at high pressure is

- (a) $1 + \frac{bP}{RT}$ (b) $1 - \frac{a}{VRT}$
 (c) 1 (d) $1 - \frac{bP}{RT}$

23. Which of the following statements is correct about the given redox reaction?



- (a) 1 mole of $\text{S}_2\text{O}_3^{2-}$ is oxidised by 8 moles of MnO_4^- .
 (b) The above redox reaction with the change of pH from 4 to 10 will have an effect on the stoichiometry of the reaction.
 (c) Change of pH from 4 to 7 will not change the nature of the product.
 (d) At pH = 9, $\text{S}_2\text{O}_3^{2-}$ ions are oxidised to HSO_4^- ions.

24. The monomer that can undergo radical, cationic and anionic polymerisation with equal ease is

- (a) $\text{Me}-\underset{\text{Me}}{\text{C}}=\text{CH}_2$ (b) $\text{Ph}-\text{CH}=\text{CH}_2$
 (c) $\text{CH}_2=\text{CH}_2$ (d) $\text{CH}_2=\text{CH}-\text{CN}$

25. Which of the following structures for a nucleotide is not correct?

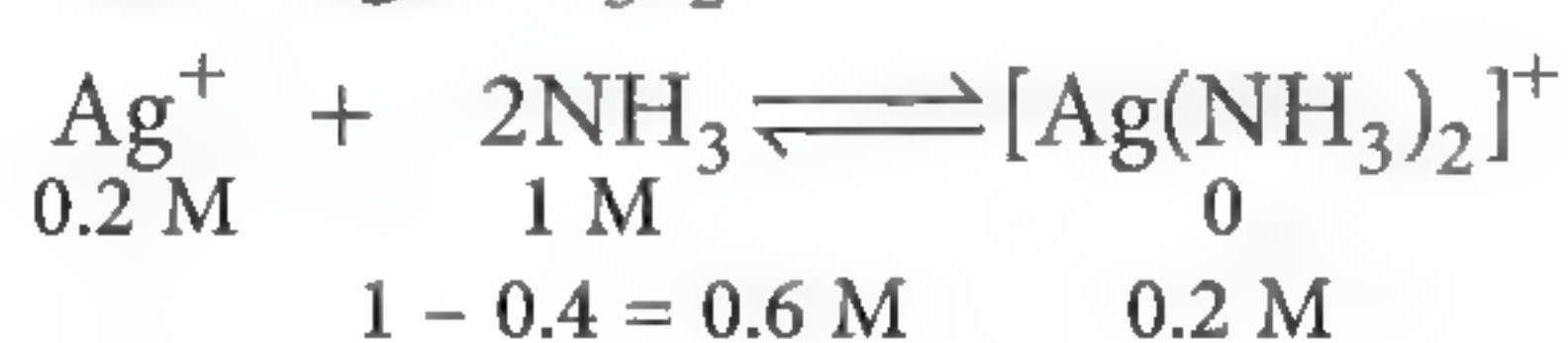
- (a) Cytosine-Ribose-Phosphate
 (b) Uracil-2-Deoxyribose-Phosphate
 (c) Uracil-Ribose-Phosphate
 (d) Thymine-2-Deoxyribose-Phosphate

SOLUTIONS

1. (b) : $[\text{Ag}^+] = 0.2 \text{ M}$, $[\text{NH}_3] = 1 \text{ M}$

$$K_{f1} \times K_{f2} = 10^7$$

Due to high K_f value, most of the Ag^+ ions get converted into $[\text{Ag}(\text{NH}_3)_2]^+$



$$\begin{array}{ccccccc} 0.2 \text{ M} & & 0 & & 0.6 \text{ M} \\ 0.2 - y \approx 0.2 & & y & & 0.6 + y \approx 0.6 \end{array}$$

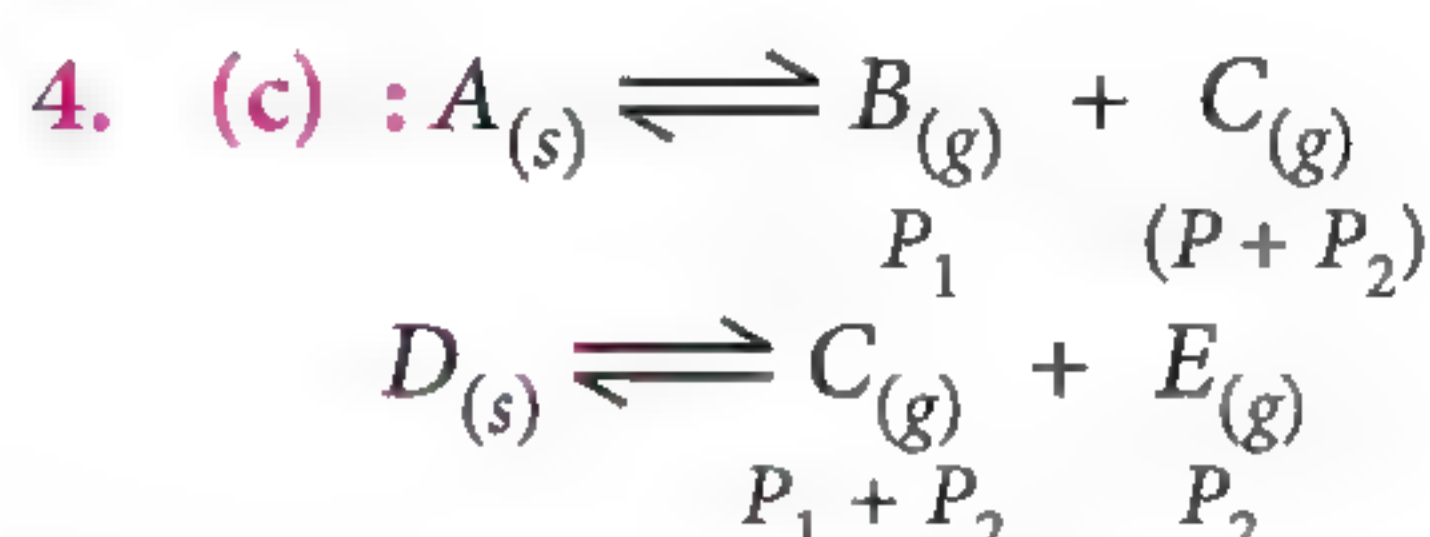
$$\frac{1}{K_{f2}} = \frac{[\text{Ag}(\text{NH}_3)]^+ [\text{NH}_3]}{[\text{Ag}(\text{NH}_3)_2]^+} \Rightarrow \frac{1}{10^4} = \frac{y \times 0.6}{0.2} = 3y$$

$$\Rightarrow y = 3.33 \times 10^{-5} \text{ M}$$

2. (a) : Percentage composition \propto time

\Rightarrow Order of reaction = zero

3. (c)



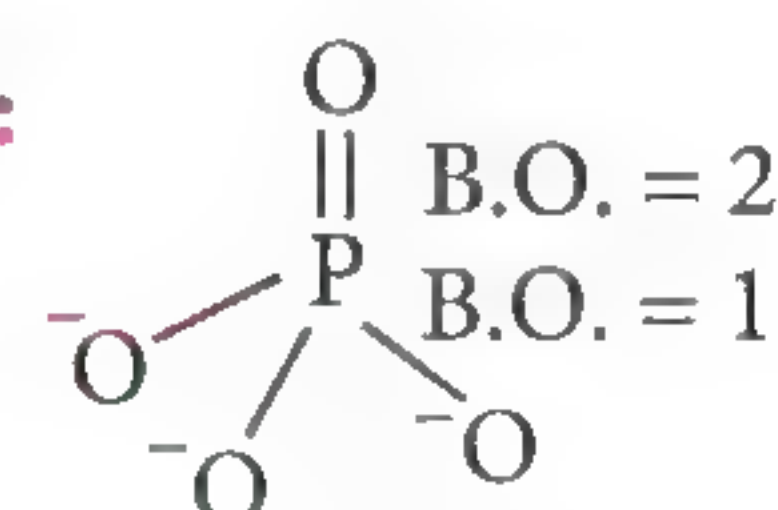
$$K_{P1} = x = P_1(P_1 + P_2) \text{ atm}^2$$

$$K_{P2} = y = P_2(P_1 + P_2) \text{ atm}^2$$

$$x + y = (P_1 + P_2)^2 \Rightarrow P_1 + P_2 = \sqrt{x + y}$$

$$P_{\text{Total}} = P_B + P_C + P_E = 2(P_1 + P_2) = 2\sqrt{x + y} \text{ atm}$$

5. (b) :



$$\text{Average B.O. of P - O bond} = \frac{2 + 1 + 1 + 1}{4}$$

$$= \frac{5}{4} = 1.25$$

6. (a) : Carbon has greater ability to form $p\pi-p\pi$ multiple bonds whereas heavier elements do not form $p\pi-p\pi$ bonds because their atomic orbitals are too large and diffuse to have effective overlapping.

7. (b) : Given, $\lambda = 4000 \text{ \AA}$

$$\nu = 6 \times 10^5 \text{ m s}^{-1}$$

$$h\nu = w_0 + \frac{1}{2} m\nu^2 \quad [w_0 = \text{work function}]$$

$$w_0 = h\nu - \frac{1}{2} m\nu^2$$

$$= \frac{6.626 \times 10^{-34} \times 3 \times 10^8}{4000 \times 10^{-10}} - \frac{1}{2} \times 9 \times 10^{-31} \times (6 \times 10^5)^2$$

$$= (4.9695 - 1.62) \times 10^{-19} = 3.3495 \times 10^{-19} \text{ J}$$

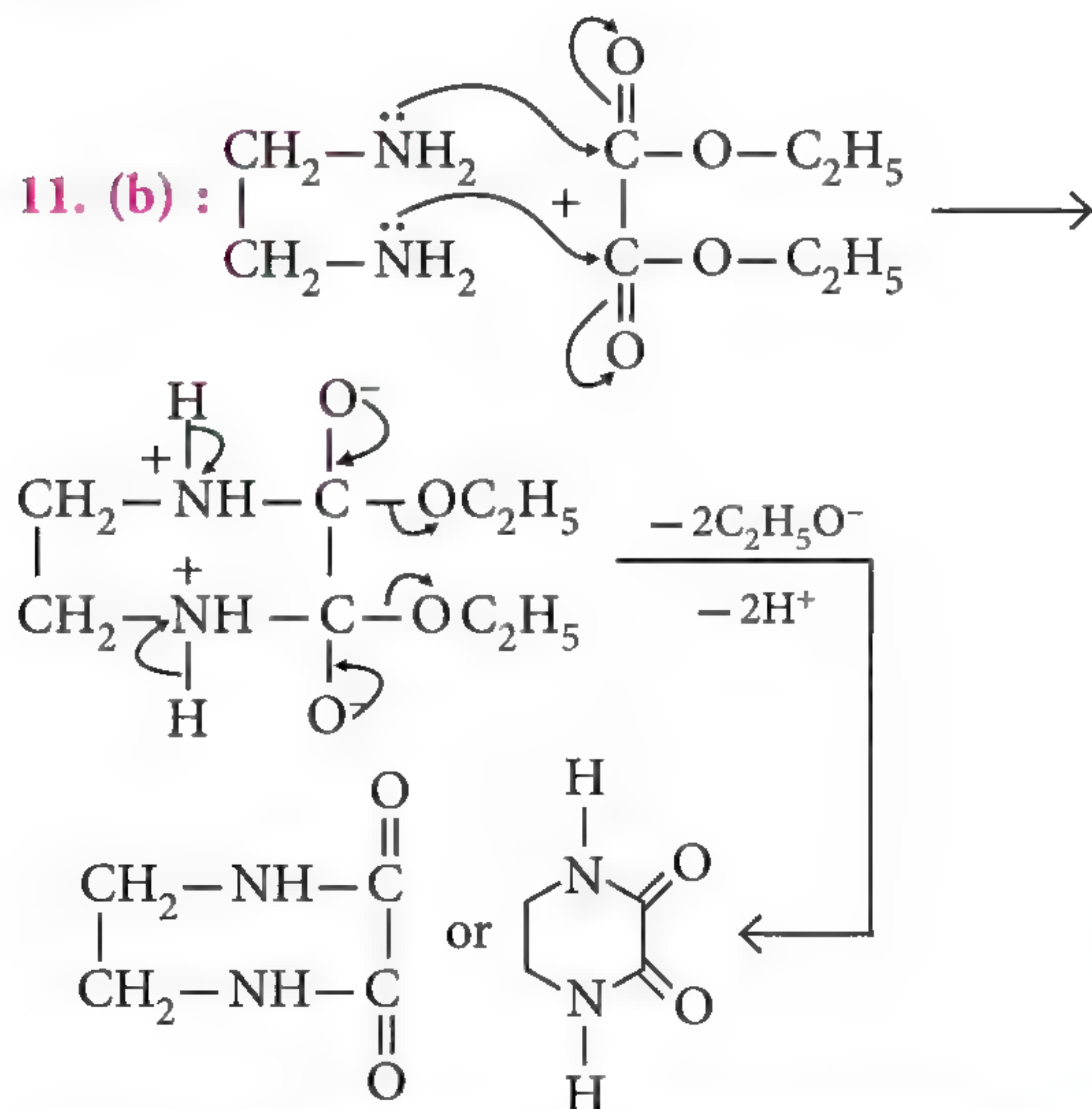
$$w_0 = \frac{3.3495 \times 10^{-19}}{1.6 \times 10^{-19}} \text{ eV} = 2.0934 \approx 2.1 \text{ eV}$$

8. (b) : $E = \frac{hc}{\lambda}$, for per mole (λ) = $\frac{hc \times N_A}{E}$

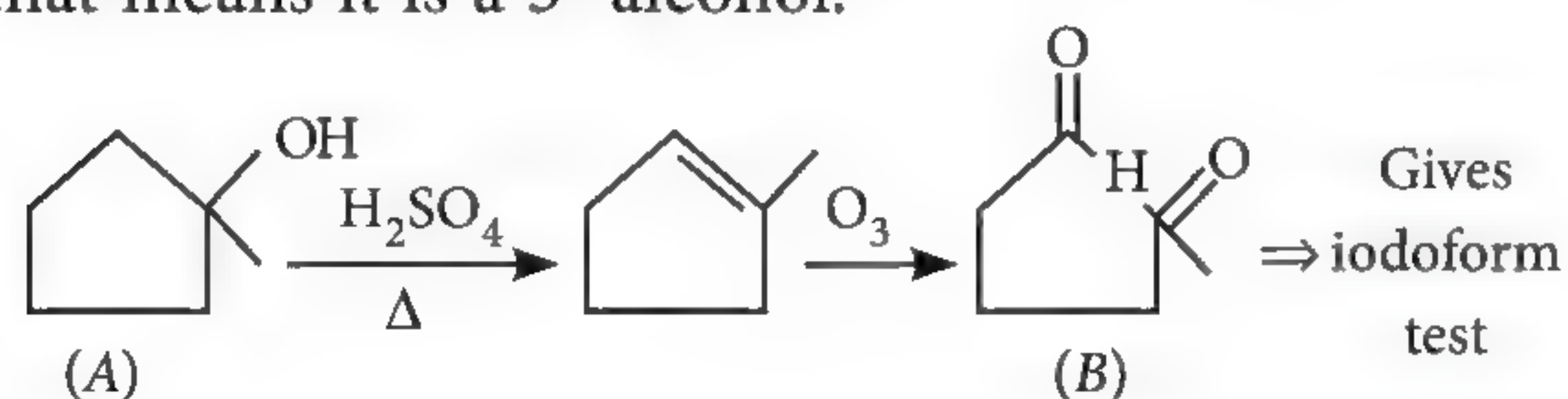
$$\lambda = \frac{6.626 \times 10^{-34} \times 10^{-3} \times 3 \times 10^8 \times 6.023 \times 10^{23}}{243} = 492 \text{ nm}$$

9. (d) : Groups at p -position on benzene ring do not form intramolecular hydrogen bond.

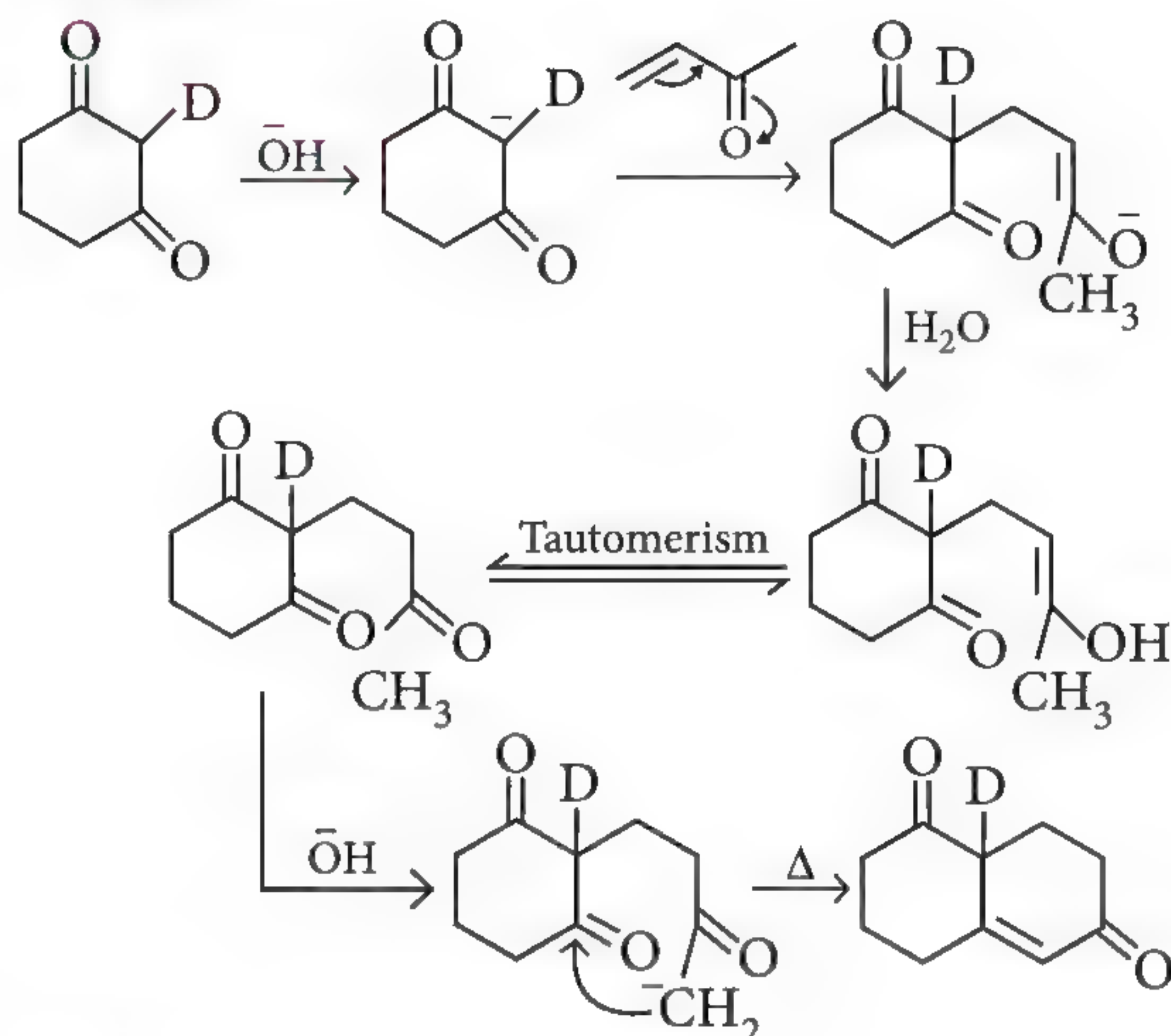
10. (c)



12. (b) : As the organic compound gives alkene on heating with H_2SO_4 and cannot be oxidised by $\text{K}_2\text{Cr}_2\text{O}_7$ that means it is a 3° alcohol.

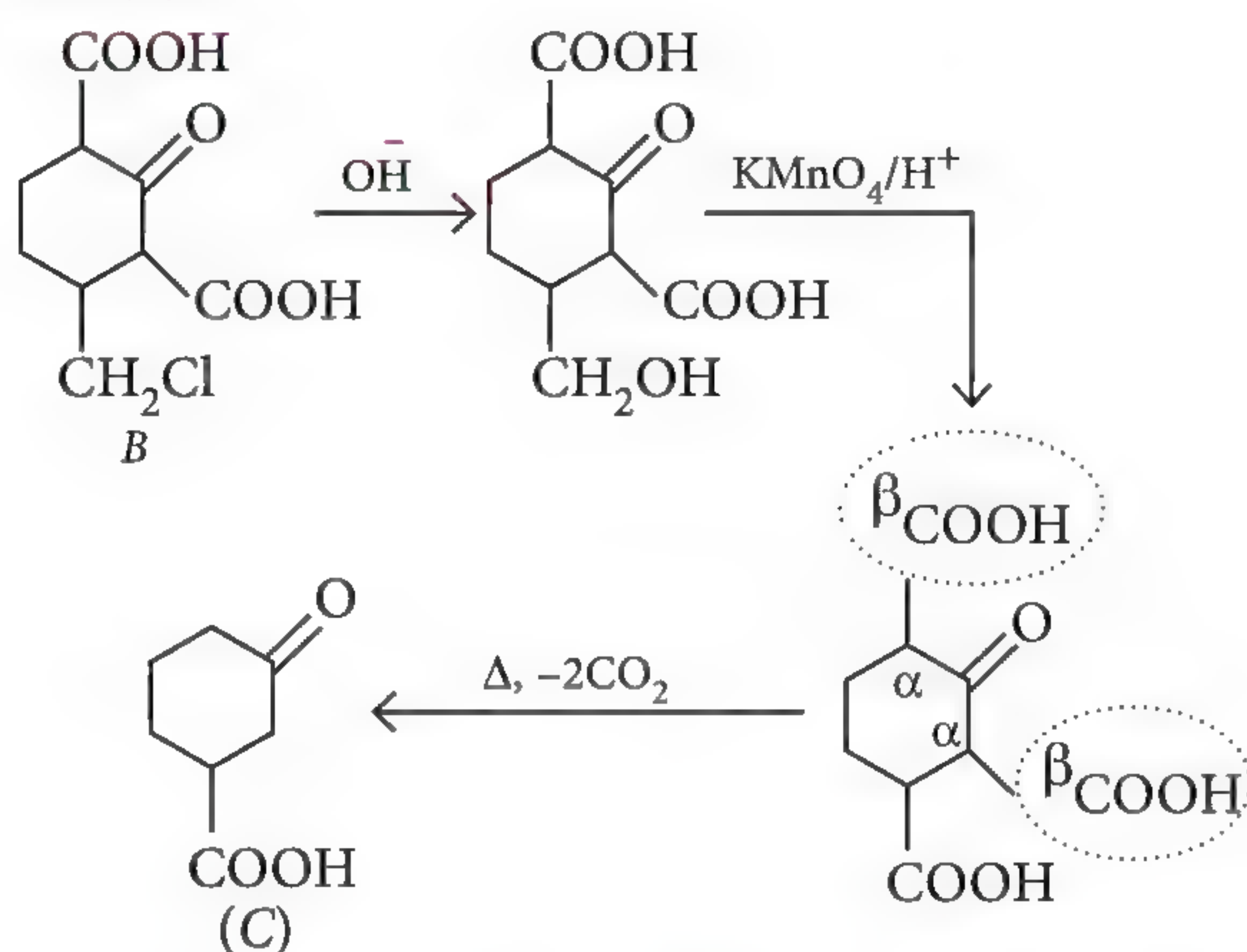


13. (b) :



14. (c)

15. (b) :



On heating, β -keto acid is easily decarboxylated.

16. (d)

17. (b)

18. (b) : ${}_{63}\text{Eu}$ has $[\text{Xe}]4f^7 6s^2$ configuration.

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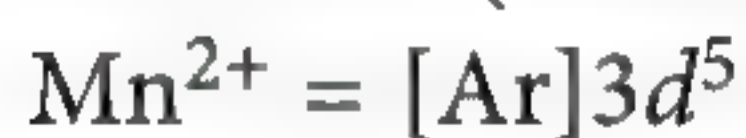
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19. (a) : $\mu = \sqrt{n(n+2)} = 5.9 \text{ B.M.}$

$\Rightarrow n = 5$ (Where, n = no. of unpaired electrons)



Five unpaired electrons in $3d$ -orbital are possible under influence of only weak field ligand. Among the given, NCS^- is relatively weak.

20. (a) : $E_{\text{cell}} = \frac{0.059}{2} \log \frac{[\text{H}^+]_{\text{cathode}}^2 \times [p_{\text{H}_2}]_{\text{anode}}}{[\text{H}^+]_{\text{anode}}^2 \times [p_{\text{H}_2}]_{\text{cathode}}}$

$[\text{OH}^-] = \sqrt{CK_b} = \sqrt{0.1 \times 10^{-5}} = 10^{-3} \text{ M}$

$[\text{H}^+]_{\text{anode}} = \frac{10^{-14}}{10^{-3}} = 10^{-11} \text{ M}$

$[\text{H}^+]_{\text{cathode}} = \sqrt{CK_a} = \sqrt{0.1 \times 10^{-7}} = 10^{-4} \text{ M}$

$\therefore E_{\text{cell}} = \frac{0.059}{2} \log \frac{(10^{-4})^2 \times 0.1}{(10^{-11})^2 \times 1} = 0.38 \text{ V}$

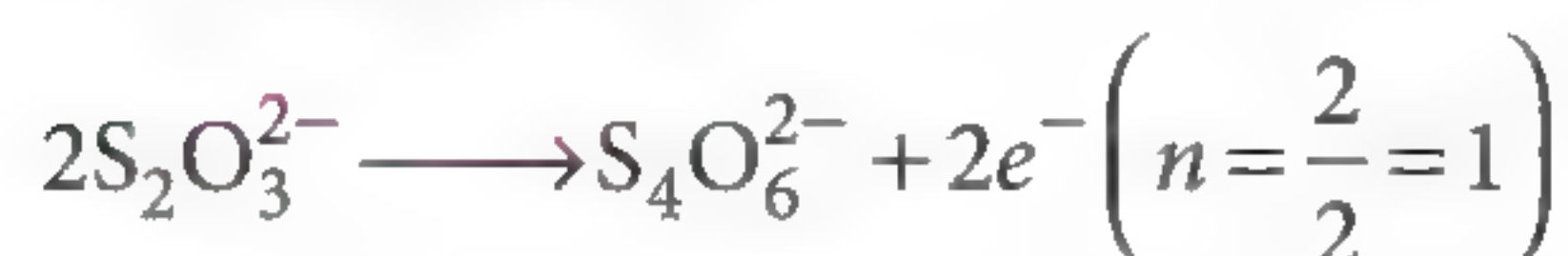
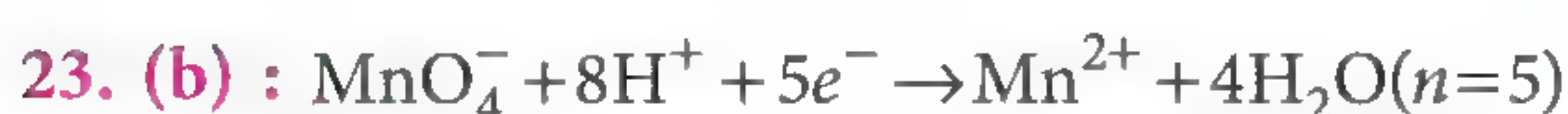
21. (a) : Adsorption $\propto T_c$

Therefore, H_2 gas shows least adsorption on a definite amount of charcoal.

22. (a) : At high pressure, b cannot be neglected. So, for 1 mole

$P(V - b) = RT \Rightarrow PV - Pb = RT$

$\Rightarrow Z = \frac{PV}{RT} = 1 + \frac{Pb}{RT}$



Equivalents of $\text{MnO}_4^- \equiv$ Equivalents of $\text{S}_2\text{O}_3^{2-}$

$5 \times \text{moles of } \text{MnO}_4^- = 1 \times \text{moles of } \text{S}_2\text{O}_3^{2-}$

$\therefore 1 \text{ mole of } \text{S}_2\text{O}_3^{2-} = 5 \text{ moles of } \text{MnO}_4^-$

(b) pH changes from 4 to 10 (acidic to strongly basic)



Equivalents of $\text{MnO}_4^- \equiv$ Equivalents of $\text{S}_2\text{O}_3^{2-}$

$\therefore 1 \text{ mole of } \text{S}_2\text{O}_3^{2-} = \frac{1}{8} \text{ mole of } \text{MnO}_4^-$

Hence, with change of pH from 4 to 10, will change the stoichiometry of reaction and also changes the product.

(c) pH changes from 4 to 7 (acidic to neutral medium) will change the nature of product.



Hence, it will also effect the stoichiometry of reaction and nature of product.

(d) At pH = 9 (basic medium), $\text{S}_2\text{O}_3^{2-}$ is oxidised to SO_4^{2-} .

24. (b) : Benzyl cation, anion and free radical all undergo polymerisation

25. (b) : Uracil is present only in RNA which contains ribose as the sugar. Thus, nucleotide given in option (b) is incorrect.

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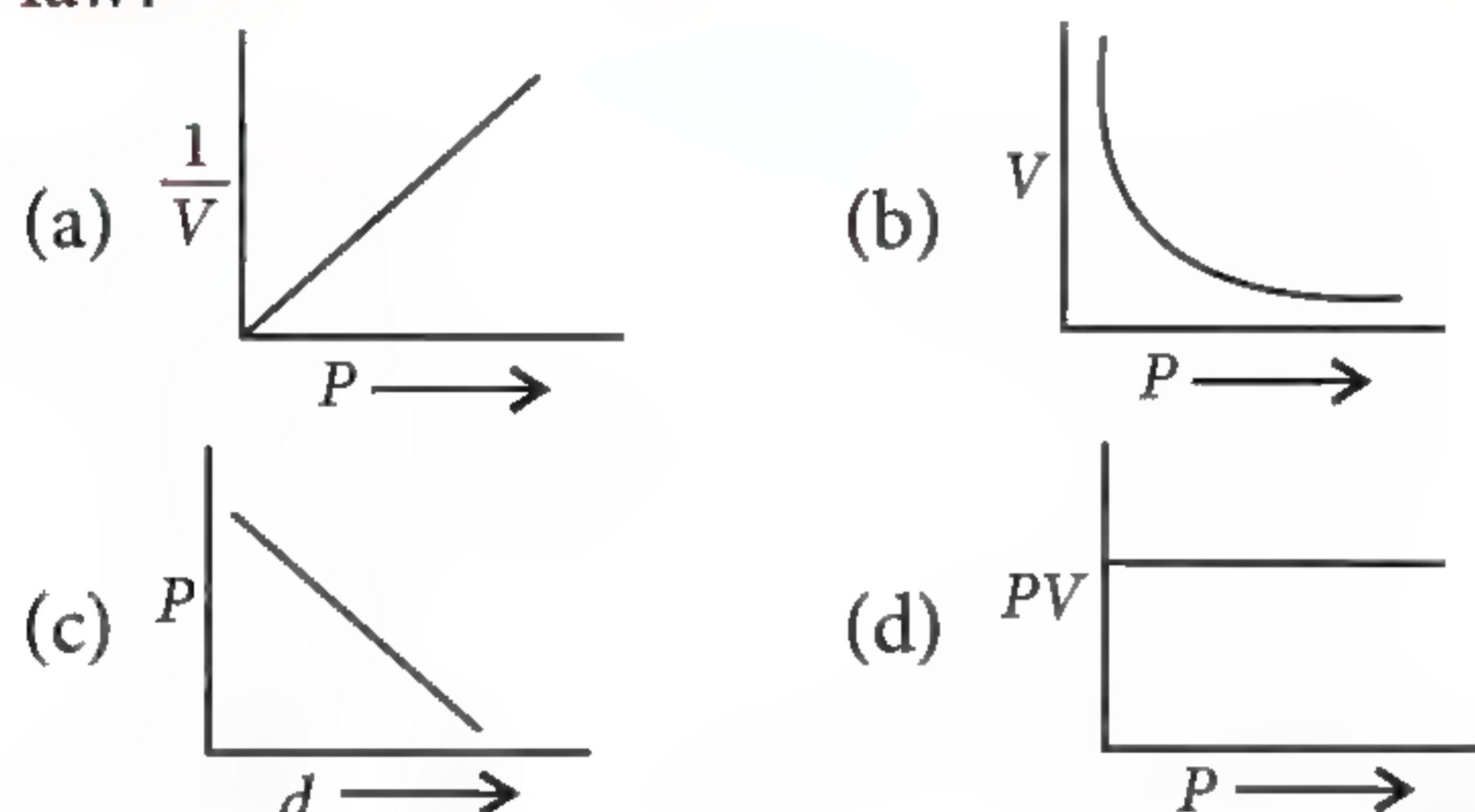
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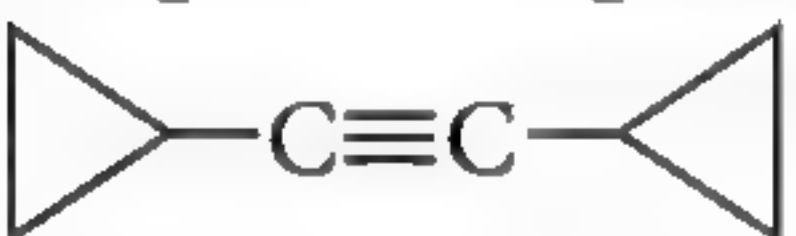
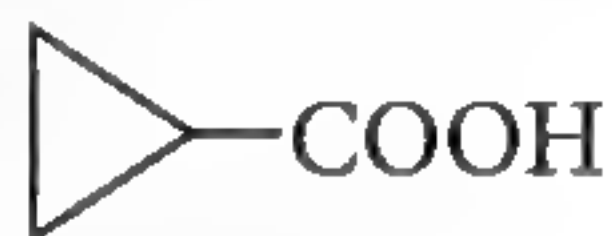
with exclusive and brain storming MCQs

Practicing these MCQs help to strengthen your concepts and give you extra edge in your JEE preparation

1. Which is not a correct representation of Boyle's law?



2. $C_8H_{10}(A)$ by oxidative cleavage forms $C_3H_5COOH(B)$. Thus, A and B respectively are

- (a) $CH_2=CHCH_2C\equiv CCH_2CH=CH_2$, $CH_2=CHCH_2COOH$
 (b) , 
 (c) both (a) and (b) are correct
 (d) none of the above is correct.

3. 17.675 is rounded off to four significant figures as

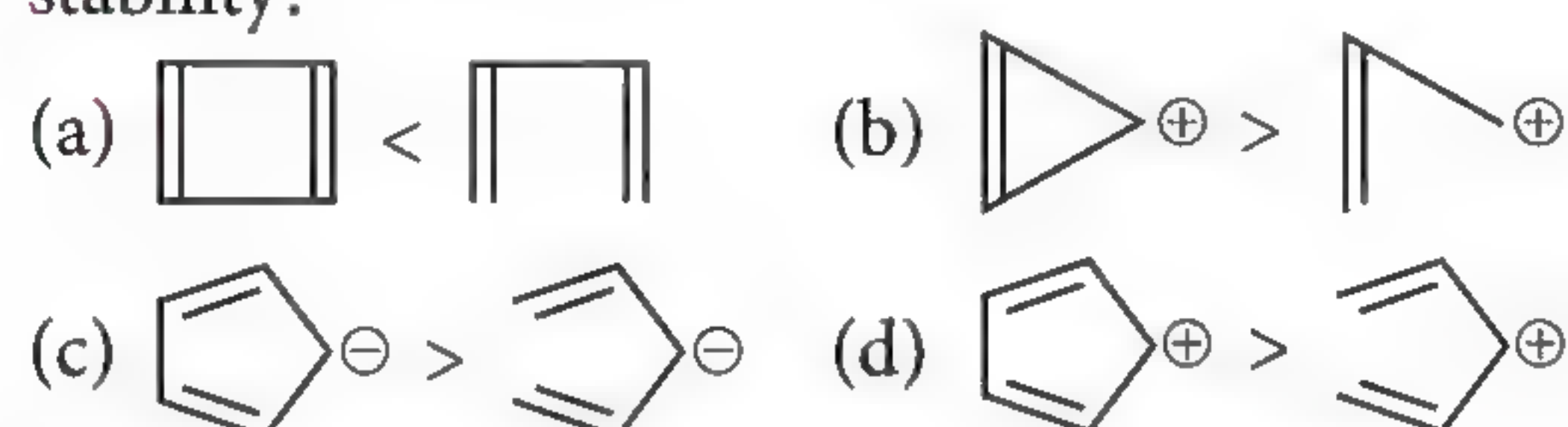
- (a) 17.68 (b) 17.67
 (c) 17.6750 (d) 17.7

4. $B \xleftarrow[200^\circ C]{\text{Strongly heated}} \underset{\text{Gypsum}}{CaSO_4 \cdot 2H_2O} \xrightarrow[Heat]{120^\circ C} A$
 \downarrow
 C

A, B and C are respectively

- (a) plaster of Paris, dead burnt plaster, calcium sulphide
 (b) dead burnt plaster, plaster of Paris, lime
 (c) plaster of Paris, dead burnt plaster, lime
 (d) anhydrous calcium sulphate, plaster of Paris, calcium sulphite.

5. Which of the following is incorrect comparison of stability?



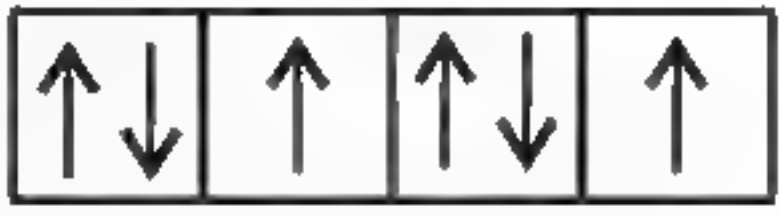


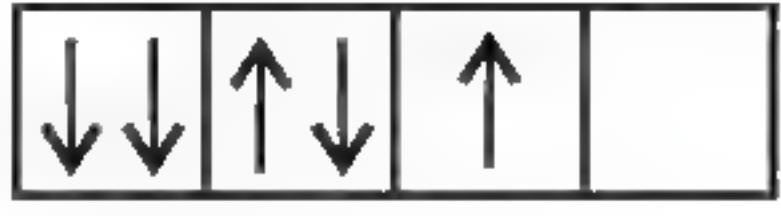
6. Which of the following statements is false?

- (a) The lower the concentration of D.O., the more polluted is the water sample.
 (b) The tolerable limit of lead in drinking water is 50 ppm.

Quotable Quote

"Do not worry too much about your difficulties in science, I can assure you that mine are still greater."

Albert Einstein

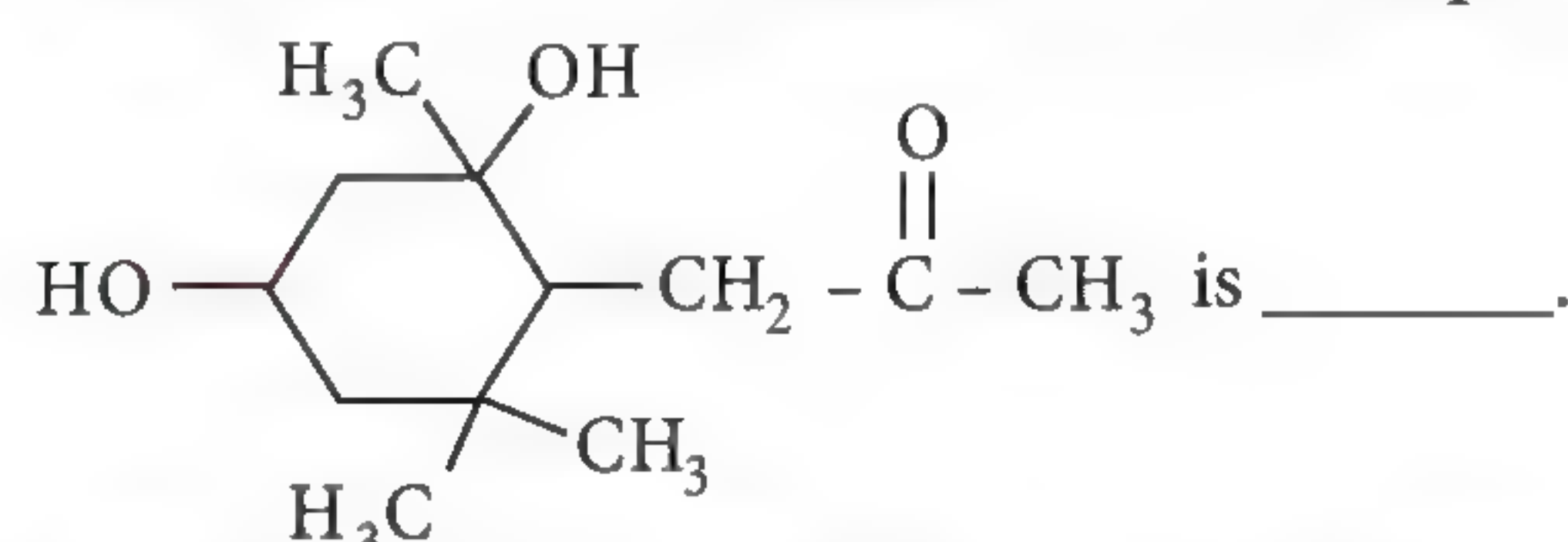
- (c) Water is considered pure if it has BOD less than 5 ppm.
- (d) In COD determination, the pollutants resistant to microbial oxidation are not oxidised by oxidising agent like $K_2Cr_2O_7$.
7. If K_1 and K_2 are respective equilibrium constants for the two reactions,
- (i) $XeF_{6(g)} + H_2O_{(g)} \rightleftharpoons XeOF_{4(g)} + 2HF_{(g)}$
- (ii) $XeO_{4(g)} + XeF_{6(g)} \rightleftharpoons XeOF_{4(g)} + XeO_3F_{2(g)}$
- the equilibrium constant for the reaction,
- $$XeO_{4(g)} + 2HF_{(g)} \rightleftharpoons XeO_3F_{2(g)} + H_2O_{(g)}$$
- will be
- (a) $\frac{K_1}{K_2^2}$ (b) $K_1 \cdot K_2$
- (c) $\frac{K_1}{K_2}$ (d) $\frac{K_2}{K_1}$
8. Element A forms an oxide A_2O_3 . What would be the formulae of its carbonate and phosphate?
- (a) $A_2(CO_3)_3, A(PO_4)_3$ (b) $A(CO_3)_3, A_2(PO_4)_3$
- (c) $A_2(CO_3)_3, A(PO_4)_3$ (d) $A_2(CO_3)_3, A_2(PO_4)_3$
9. In which of the following orbital diagrams are both Pauli's exclusion principle and Hund's rule violated?
- (a)  (b) 
- (c)  (d) 
10. Ge(II) compounds are powerful reducing agents whereas Pb(IV) compounds are strong oxidants. This can be due to
- (a) Pb is more electropositive than Ge
- (b) ionization potential of Pb is less than that of Ge
- (c) ionic radii of Pb^{2+} and Pb^{4+} are larger than those of Ge^{2+} and Ge^{4+}
- (d) more pronounced inert pair effect in Pb than in Ge.

NUMERICAL PROBLEMS

11. The kinetic energy of an electron in the second Bohr orbit of a hydrogen atom is equal to $\frac{h^2}{x m a_0^2}$. The value of $10x$ is _____. (a_0 is radius of Bohr's orbit.)
[Given : $\pi = 3.14$]
12. Diborane reacts with ammonia to form an adduct which on heating at 473 K decomposes to give a

volatile compound called borazine. The number of π -bonds in borazine is _____.

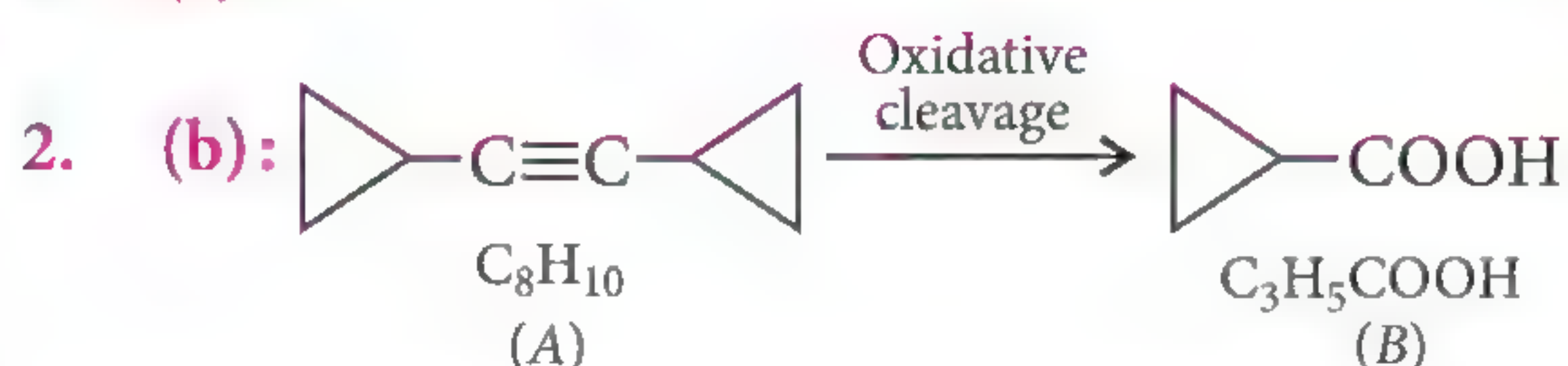
13. Total number of stereoisomers for the compound



14. ΔH_f° of water is $-285.8 \text{ kJ mol}^{-1}$. If enthalpy of neutralisation of monoacidic strong base is $-57.3 \text{ kJ mol}^{-1}$, ΔH_f° of OH^- ion (in kJ mol^{-1}) will be _____. (without sign).
15. Lemon juice normally has a pH of 2. If all the acid in the lemon juice is citric acid and there are no citrate salts present, then the citric acid concentration (H.Cit) in the lemon juice is found to be $x \times 10^{-2}$, then the value of x is _____. (Assume that only the first hydrogen of citric acid is important).
($H.Cit \rightleftharpoons H^+ + Cit^-$; $K_a = 8.4 \times 10^{-4} \text{ mol lit}^{-1}$)

SOLUTIONS

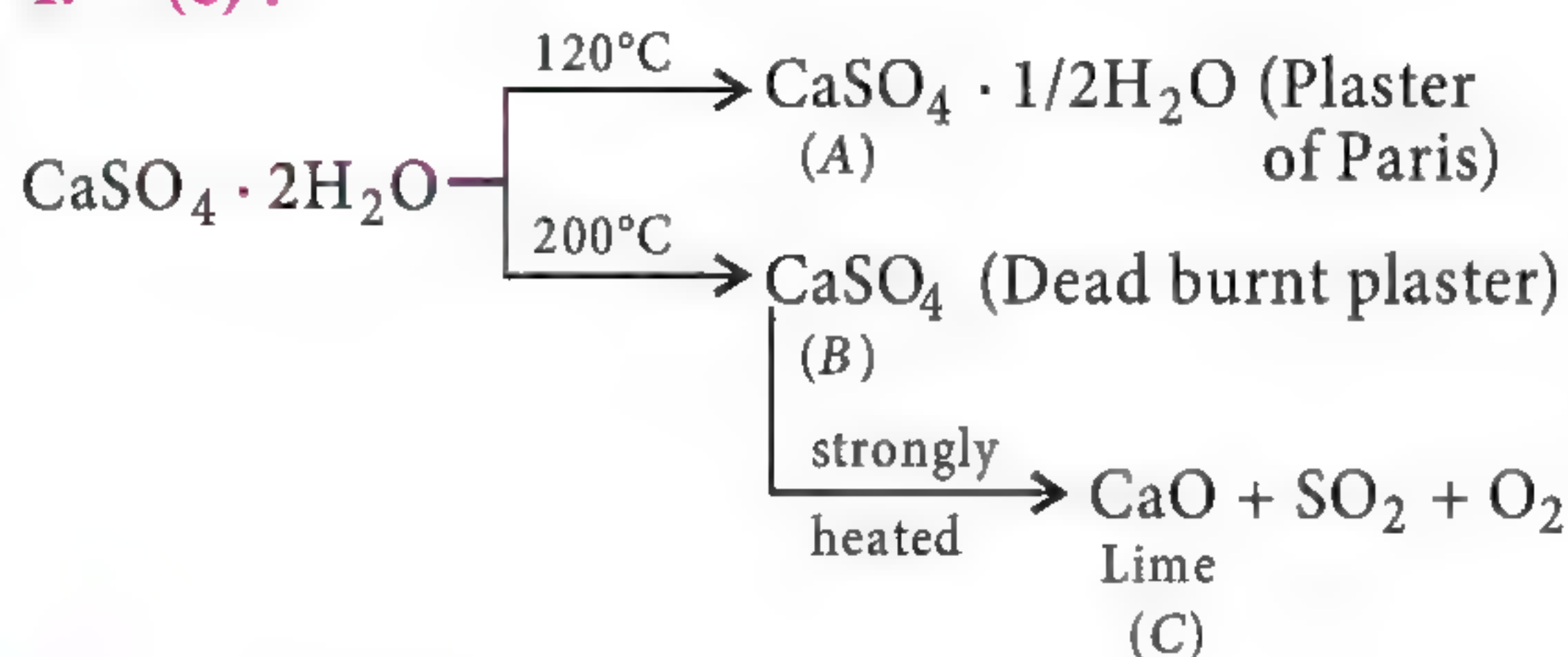
1. (c)

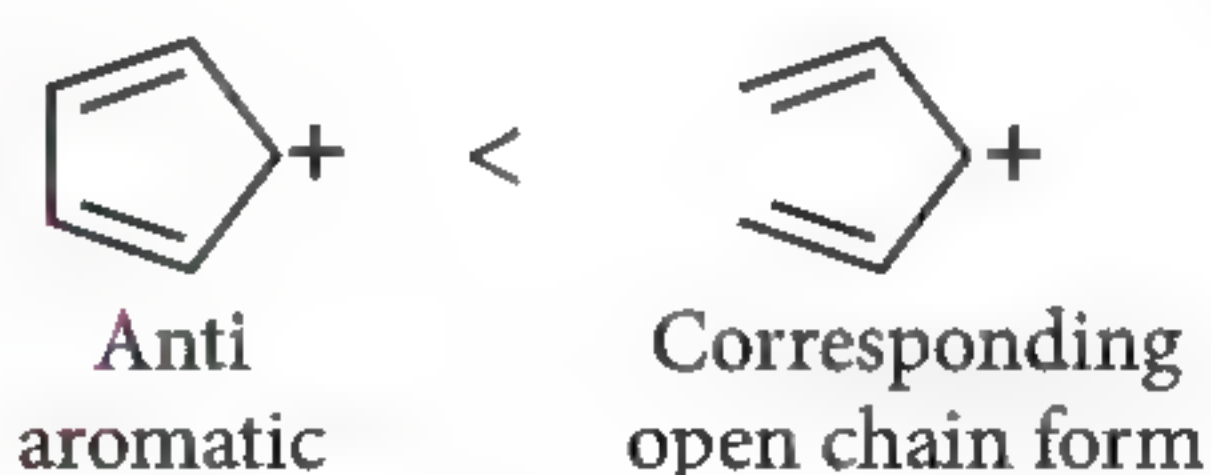


Formation of B indicates that A is symmetrical.

3. (a)

4. (c):



5. (d): 

6. (d): In COD determination, both organic and inorganic pollutants are oxidised by oxidising agent like $K_2Cr_2O_7$.

7. (d): Addition of reaction (ii) and reverse of reaction

(i) gives the desired reaction hence, $K = K_2 \times \frac{1}{K_1} = \frac{K_2}{K_1}$.

8. (c): $A_2O_3 \Rightarrow$ Valency of A is 3.

So, the formulae of carbonate (CO_3^{2-}) will be $A_2(CO_3)_3$ and that of phosphate (PO_4^{3-}) will be $A(PO_4)_3$.

9. (d): Two electrons with parallel spins in the same orbital are violating Pauli's exclusion principle whereas pairing without single occupancy of all orbitals is violating Hund's rule.

10. (d): Ge^{4+} is more stable than Ge^{2+} as a result of which Ge^{2+} has a tendency to be oxidised to Ge^{4+} so, Ge^{2+} compounds act as powerful reducing agents. But Pb^{2+} is more stable than Pb^{4+} because of pronounced inert pair effect as a result of which Pb^{4+} has a tendency to get reduced to Pb^{2+} so, Pb^{4+} compounds act as strong oxidising agents (i.e., oxidants).

11. (3155): Kinetic energy in Bohr atom $= \frac{n^2 h^2}{8m\pi^2 r^2}$

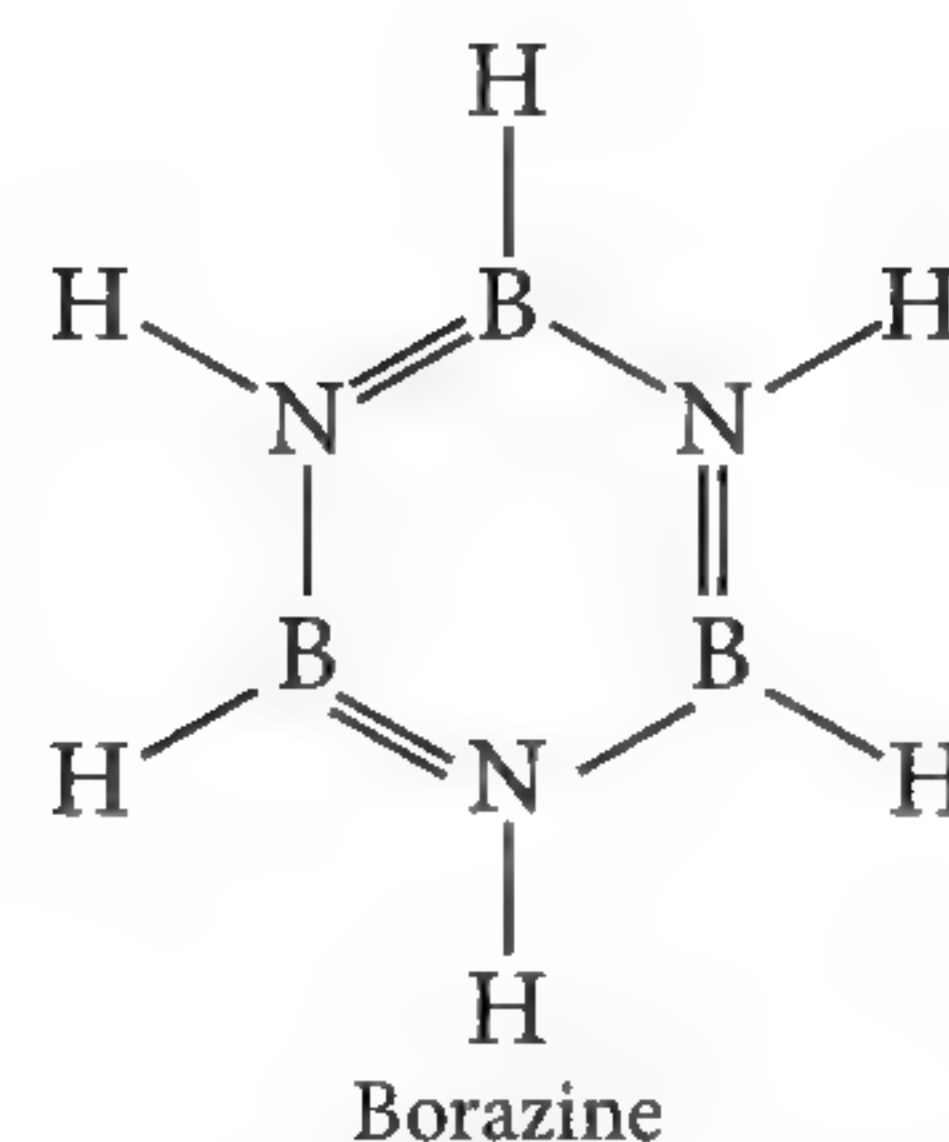
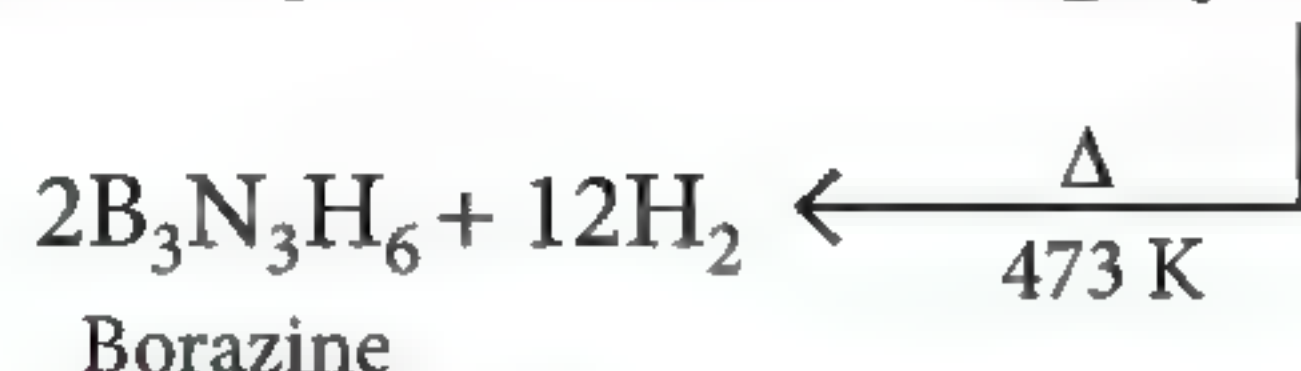
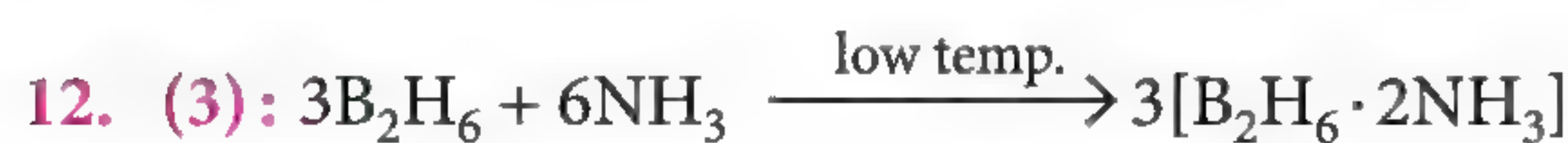
For second Bohr orbit $n = 2$, $r_2 = (2)^2 a_0 = 4a_0$

$$K.E. = \frac{(2)^2 h^2}{8 \times m(4a_0)^2 \times \pi^2} = \frac{h^2}{32\pi^2 a_0^2 m} \quad \dots(i)$$

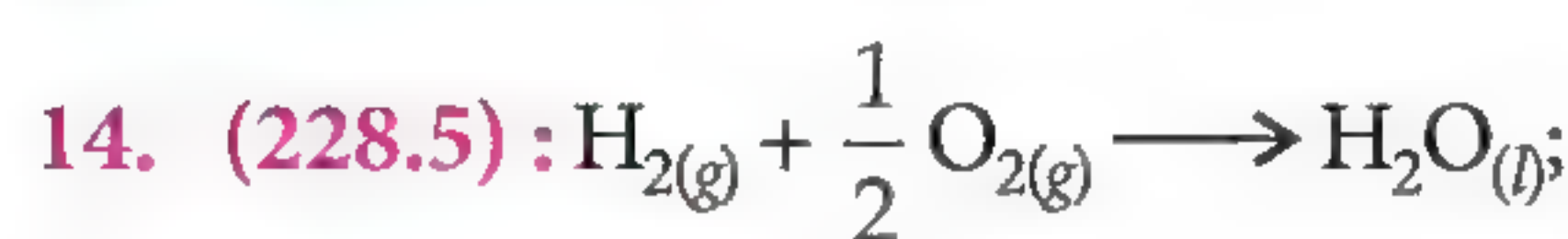
$$\text{Given, } K.E. = \frac{h^2}{xma_0^2} \quad \dots(ii)$$

$$x = 32\pi^2$$

$$10x = 32 \times 10 \times 3.14 \times 3.14 = 3155$$



13. (8): It has three chiral carbons, hence number of stereoisomers (2^3) will be 8.

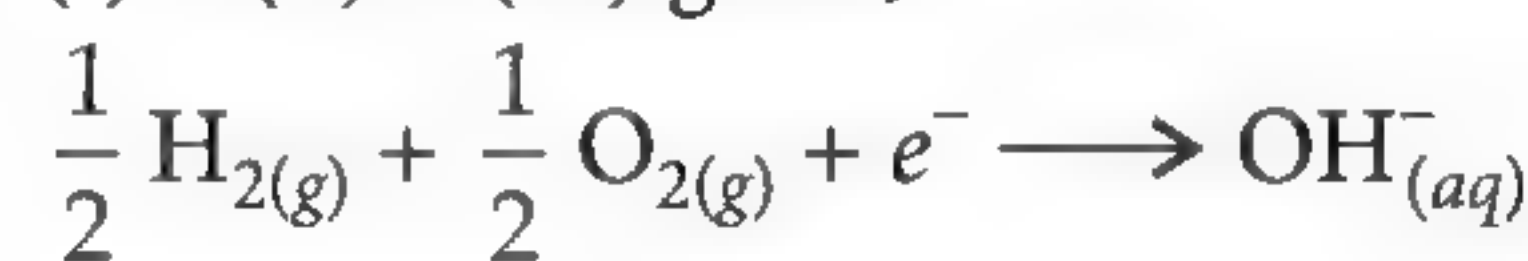


$$\Delta H_f^\circ = -285.8 \text{ kJ mol}^{-1} \quad \dots(i)$$

$$H_{(aq)}^+ + OH_{(aq)}^- \longrightarrow H_{2O(l)}; \Delta H_{neut}^\circ = -57.3 \text{ kJ mol}^{-1} \quad \dots(ii)$$

$$\frac{1}{2} H_{2(g)} \longrightarrow H_{(aq)}^+ + e^-; \Delta H_f^\circ = 0 \text{ (by convention)} \quad \dots(iii)$$

(i) - (ii) - (iii) gives,



$$\Delta H_f^\circ \text{ of } OH^- = -285.8 + 57.3 = -228.5 \text{ kJ mol}^{-1}$$

15. (12): $K_a = \frac{[H^+][cit^-]}{[H. cit]}$

$$8.4 \times 10^{-4} = \frac{[10^{-2}][10^{-2}]}{[H. cit]}; 8.4 \times 10^{-4} = \frac{10^{-4}}{[H. cit]}$$

$$[H. cit] = \frac{10^{-4}}{8.4 \times 10^{-4}} = 0.119$$

$$= 11.9 \times 10^{-2} \text{ M} \approx 12 \times 10^{-2} \text{ M}$$



PUBLIC NOTICE

JEE MAIN 2022

Sub: Rescheduling the Dates for Joint Entrance Examination (Main) – 2022 Session 1 and Session 2

In continuation to the Public Notice dated: 14 March 2022, National Testing Agency has decided to reschedule the dates of JEE (Main) – 2022 Session 1 and Session 2 based on the numerous representations received from the candidates. The revised schedule is as follows:

Exam/Session	Earlier Dates	Revised Dates	Intimation of City	Downloading of Admit Card
JEE (Main) – 2022 Session 1	21, 24, 25, 29 April, and 1, 4 May 2022	20, 21, 22, 23, 24, 25, 26, 27, 28, and 29 June 2022	To be intimated later on the JEE (Main) website.	
JEE (Main) – 2022 Session 2	24, 25, 26, 27, 28, and 29 May 2022	21, 22, 23, 24, 25, 26, 27, 28, 29 and 30 July 2022		

The Candidates are advised to keep visiting the official websites of NTA (www.nta.ac.in) and (<https://jeemain.nta.nic.in/>) for the latest updates.

For further clarification related to JEE (Main) – 2022, the candidates can also contact 011-40759000/011-69227700 or email at jeemain@nta.ac.in.

MONTHLY TEST DRIVE

Practice Paper



This specially designed column enables students to self analyse their extent of understanding the complete syllabus. Give yourself four marks for each correct answer and deduct one mark for each wrong answer. Self check table given at the end will help you to check your readiness.

Total Marks : 120

Time Taken : 60 Min.

NEET

Only One Option Correct Type

1. (I) $\text{H}_2\text{O}_2 + \text{O}_3 \longrightarrow \text{H}_2\text{O} + 2\text{O}_2$
(II) $\text{H}_2\text{O}_2 + \text{Ag}_2\text{O} \longrightarrow 2\text{Ag} + \text{H}_2\text{O} + \text{O}_2$
Role of hydrogen peroxide in the above reactions is respectively
(a) oxidising in (I) and reducing in (II)
(b) reducing in (I) and oxidising in (II)
(c) reducing in (I) and (II)
(d) oxidising in (I) and (II).



The above hydration can be carried out by

- (a) acid catalysed hydration
(b) oxymercuration-demercuration
(c) hydroboration-oxidation
(d) none of the above methods.
3. Which of the following reactions is said to be entropy driven?
(a) Endothermic reaction with positive entropy change and high temperature
(b) Endothermic reaction with negative entropy change and low temperature
(c) Exothermic reaction with positive entropy change and high temperature
(d) Exothermic reaction with negative entropy change and low temperature
4. When LiNO_3 is heated, it gives oxide, Li_2O , whereas other alkali metal nitrates decompose to give corresponding
(a) nitrite (b) peroxide
(c) both nitrite and oxide
(d) none of these.
5. Which of the following alkali metal ions has the highest conductivity in aqueous solution?

- (a) Li^+ (b) Cs^+ (c) Na^+ (d) K^+

6. Which of the following practices involve green chemistry?
(I) Substitute CFCs by environmental friendly HFCs and other compounds.
(II) Replace halogenated solvent by liquid CO_2 for dry cleaning.
(III) Use of H_2O_2 for bleaching instead of Cl_2 .
(IV) Making disposable eating utensils and storage jars of plastics.
(a) (I) and (II) (b) (II) and (IV)
(c) (III) and (IV) (d) (I), (II) and (III)
7. Out of N_2O , SO_2 , I_3^+ , I_3^- , H_2O , NO_2^- , N_3^- , the linear species are
(a) NO_2^- , I_3^+ , H_2O (b) N_2O , I_3^+ , N_3^-
(c) N_2O , I_3^- , N_3^- (d) N_3^- , I_3^- , NO_2^-
8. The two equilibrium $\text{AB} \rightleftharpoons \text{A}^+ + \text{B}^-$ and $\text{AB} + \text{B}^- \rightleftharpoons \text{AB}_2^-$ are simultaneously maintained in a solution with equilibrium constant K_1 and K_2 respectively. The ratio of $[\text{A}^+]$ to $[\text{AB}_2^-]$ in the solution is
(a) directly proportional to the concentration of B^-
(b) inversely proportional to the concentration of B^-
(c) directly proportional to the square of the concentration of B^-
(d) inversely proportional to the square of the concentration of B^- .
9. Which set of quantum numbers is possible for the outermost electron of Mg^+ ion?
(a) $n = 3, l = 2, m = 0, s = +1/2$
(b) $n = 2, l = 3, m = 0, s = +1/2$
(c) $n = 1, l = 0, m = 0, s = +1/2$
(d) $n = 3, l = 0, m = 0, s = +1/2$
10. The decreasing order of the ionisation enthalpy of the following elements is

- (a) $\text{Ne} > \text{Cl} > \text{P} > \text{S} > \text{Al} > \text{Mg}$
 (b) $\text{Ne} > \text{Cl} > \text{P} > \text{S} > \text{Mg} > \text{Al}$
 (c) $\text{Ne} > \text{Cl} > \text{S} > \text{P} > \text{Mg} > \text{Al}$
 (d) $\text{Ne} > \text{Cl} > \text{S} > \text{P} > \text{Al} > \text{Mg}$

11. When one mole of a gas is heated at constant volume, temperature is raised from 298 to 308 K. Heat supplied to gas is 500 J. Then which of the following is correct?

- (a) $q = W = 500 \text{ J}, \Delta U = 0$
 (b) $q = \Delta U = 500 \text{ J}, W = 0$
 (c) $q = W = 500 \text{ J}, \Delta U = 500$
 (d) $\Delta U = 0, q = W = -500 \text{ J}$

12. Which of the following electronic configurations has zero spin multiplicity?

- (a) $\uparrow \uparrow \uparrow$ (b) $\uparrow \uparrow \downarrow$
 (c) $\uparrow \downarrow \downarrow$ (d) $\downarrow \downarrow \downarrow$

Scientist of the Month

Louis Pasteur

Early Life and Education

- Louis Pasteur was born on 27 December 1822, in Dole, Jura, France, to a Catholic family of a poor tanner. He was an average student in his early years, and not particularly academic, as his interests were fishing and sketching.
- In 1839, he entered the Collège Royal at Besançon to study philosophy and earned his Bachelor of Letters degree in 1840.
- He managed to pass the baccalauréat scientifique (general science) degree from Dijon, where he earned his Bachelor of Science in Mathematics degree in 1842, but with a mediocre grade in chemistry.
- Later in 1842, Pasteur took the entrance test for the École Normale Supérieure. He passed the first set of tests, but his ranking was low. In 1843, he passed the test with a high ranking and entered the École Normale Supérieure. In 1845 he received the licencié ès sciences degree.



Louis Pasteur

(27 December 1822 – 28 September 1895)

Scientific Contributions

Molecular Asymmetry

- In Pasteur's early work as a chemist, beginning at the École Normale Supérieure, and continuing at Strasbourg and Lille, he examined the chemical, optical and crystallographic properties of a group of compounds known as tartrates.
- He resolved a problem concerning the nature of tartaric acid in 1848. A solution of this compound derived from living things rotated the plane of polarization of light passing through it.
- Pasteur determined that optical activity related to the shape of the crystals, and that an asymmetric internal arrangement of the molecules of the compound was responsible for twisting the light.

Fermentation and Germ Theory of Diseases

- Pasteur was motivated to investigate fermentation while working at Lille.
- He developed his ideas stating that "Sugar is decomposed into alcohol and carbonic acid, so there is a particular ferment, a lactic yeast, always present when sugar becomes lactic acid".
- Pasteur's research also showed that the growth of microorganisms was responsible for spoiling beverages, such as beer, wine and milk. With this established, he invented a process in which liquids such as milk were heated to a temperature between 60 and 100 °C. This killed most bacteria and moulds already present within them. Pasteur patented the process, to fight the "diseases" of wine, in 1865. The method became to known as pasteurization, and was soon applied to beer and milk.
- Beverage contamination led Pasteur to the idea that microorganisms infecting animals and humans cause disease. He proposed preventing

the entry of microorganisms into the human body, leading Joseph Lister (a British surgeon) to develop antiseptic methods in surgery.

Spontaneous Generation

- Following his fermentation experiments, Pasteur demonstrated that the skin of grapes was the natural source of yeasts, and that sterilized grapes and grape juice never fermented.

Immunology and Vaccination

- Pasteur's first work on vaccine development was on chicken cholera. He received the bacteria samples (later called *Pasteurella multocida* after him) from Henry Toussaint (a French veterinarian). He started the study in 1877, and by the next year, was able to maintain a stable culture using broths. After another year of continuous culturing, he found that the bacteria were less pathogenic.
- In December 1880, Pasteur presented his results to the French Academy of Sciences as "Sur les maladies virulentes et en particulier sur la maladie appelée vulgairement choléra des poules (On virulent diseases, and in particular on the disease commonly called chicken cholera)" and published it in the academy's journal.
- In the 1870, he applied this immunization method to anthrax, which affected cattle, and aroused interest in combating other diseases. Pasteur cultivated bacteria from the blood of animals infected with anthrax. When he inoculated animals with the bacteria, anthrax occurred, proving that the bacteria was the cause of the disease.

Awards and Honors

- Pasteur was awarded 1,500 francs in 1853 by the Pharmaceutical Society for the synthesis of racemic acid.
- In 1856 the Royal Society of London presented him the Rumford Medal for his discovery of the nature of racemic acid and its relations to polarized light, and the Copley Medal in 1874 for his work on fermentation.
- The French Academy of Sciences awarded Pasteur the 1859 Montyon Prize for experimental physiology in 1860, and the Jecker Prize in 1861 and the Alhumbert Prize in 1862 for his experimental refutation of spontaneous generation.
- In 1873 Pasteur was elected to the Académie Nationale de Médecine and was made the commander in the Brazilian Order of the Rose.
- Pasteur received the Albert Medal from the Royal Society of Arts in 1882.
- He was awarded the Cameron Prize for Therapeutics of the University of Edinburgh in 1889.
- Pasteur won the Leeuwenhoek Medal from the Royal Netherlands Academy of Arts and Sciences for his contributions to microbiology in 1895.
- Pasteur was made a Chevalier of the Legion of Honour in 1853, promoted to Officer in 1863, to Commander in 1868, to Grand Officer in 1878 and made a Grand Cross of the Legion of Honor in 1881.

Assertion & Reason Type

Directions : In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as :

- (a) If both assertion and reason are true and reason is the correct explanation of assertion.
 (b) If both assertion and reason are true but reason is not the correct explanation of assertion.
 (c) If assertion is true but reason is false.
 (d) If both assertion and reason are false.

13. Assertion : Heavy water has slightly higher values of physical constants like boiling point, melting point, density, viscosity etc. than water.

Reason : Heavy water has higher molecular mass as compared to ordinary water.

14. Assertion : Spontaneous process is an irreversible process and may be reversed by some external agency.

Reason : Decrease in enthalpy is a contributory factor for spontaneity.

15. Assertion : All the hydrogen atoms in $\text{CH}_2=\text{C}=\text{CH}_2$ lie in one plane.

Reason : All the carbon atoms in it are sp^2 hybridised.

JEE MAIN / JEE ADVANCED

Only One Option Correct Type

16. A sample of gas has a volume of V_1 litre at temperature $t_1^\circ\text{C}$. When the temperature of the gas is changed to $t_2^\circ\text{C}$ at constant pressure, then the volume of the gas was found to increase by 10%. The percentage increase in temperature is

- (a) 10% (b) $\left(10 + \frac{2730}{t_1}\right)\%$
 (c) 20% (d) $(0.1 + t_1^{-1})\%$

17. 29.5 mg of an organic compound containing nitrogen was digested according to Kjeldahl's method and the evolved ammonia was absorbed in 20 mL of 0.1 M HCl solution. The excess of the acid required 15 mL of 0.1 M NaOH solution for complete neutralisation. The percentage of nitrogen in the compound is

- (a) 29.5 (b) 59.0 (c) 47.4 (d) 23.7

18. A welding fuel gas contains carbon and hydrogen only. Burning a small sample of it in oxygen gives 3.38 g carbon dioxide, 0.690 g of water and no other products. A volume of 10.0 L (measured at STP) of this welding gas is found to weigh 11.6 g. The molecular formula of gas is

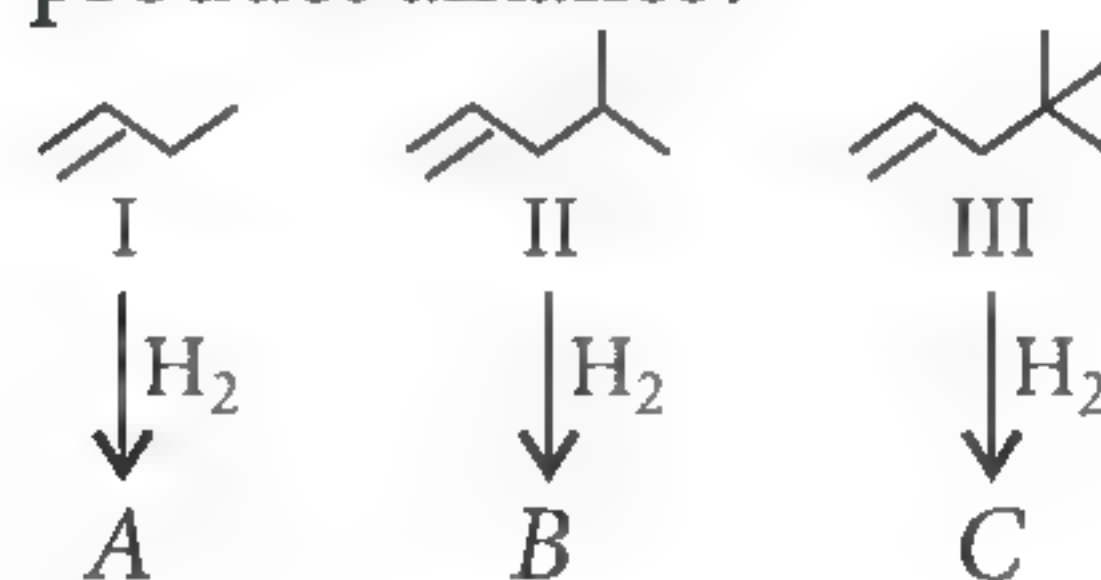
- (a) C_2H_2 (b) CH_4 (c) C_2H_4 (d) C_2H_6

19. The increasing order of atomic radii of the following group 13 elements is

- (a) $\text{Al} < \text{Ga} < \text{In} < \text{Tl}$ (b) $\text{Ga} < \text{Al} < \text{In} < \text{Tl}$
 (c) $\text{Al} < \text{In} < \text{Ga} < \text{Tl}$ (d) $\text{Al} < \text{Ga} < \text{Tl} < \text{In}$

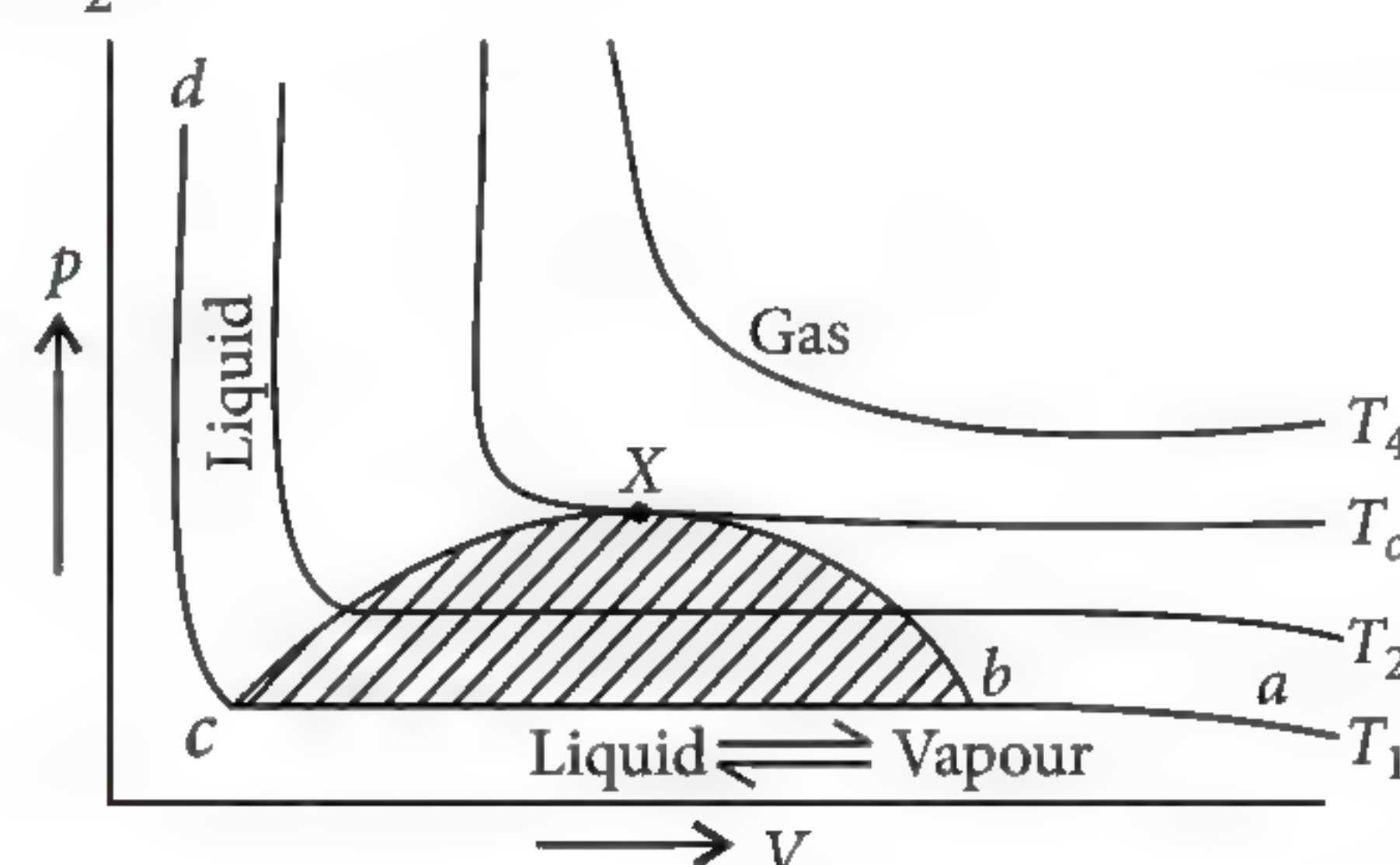
More Than One Options Correct Type

20. Which of the following statements is/are correct regarding stability of the parent alkenes and the product alkanes?



- (a) All alkenes are equally stable.
 (b) Alkene III is more stable than I and II.
 (c) All alkanes are equally stable.
 (d) Alkane C is more stable than A and B.

21. Which is/are correct for the graph for liquefaction of CO_2 ?



- (a) At the point c, the liquefaction is complete and the curve cd represents the variation of V with p of the liquid state.
 (b) The pressure corresponding to the line bc is known as the vapour pressure of the liquid.
 (c) For every gas, there is a limit of temperature above which it cannot be liquefied, no matter what the pressure is.
 (d) At temperature T_c , the horizontal pressure is reduced to a mere point. At temperature higher than T_c , there is liquefaction of gas.

22. Which of the following statements are true?

- (a) Metallic and covalent radii of potassium are 2.3 Å and 2.03 Å respectively.
 (b) Atomic and ionic radii of niobium and tantalum are almost same.
 (c) Ionisation energy is inversely proportional to the screening effect.
 (d) The first ionisation energies of Be and Mg are more than ionisation energies of B and Al respectively.

23. The crystalline form of borax has
 (a) tetranuclear $[\text{B}_4\text{O}_5(\text{OH})_4]^{2-}$ unit
 (b) all boron atoms in the same plane
 (c) equal number of sp^2 and sp^3 hybridized boron atoms
 (d) one terminal hydroxide per boron atom.

Integer / Numerical Value Type

24. The number of species among the following which have fractional bond order is _____.
 $\text{Li}_2, \text{He}_2^+, \text{N}_2^+, \text{N}_2^{2-}, \text{O}_2^+, \text{O}_2^{2-}, \text{O}_2^-, \text{CO}_3^{2-}, \text{C}_6\text{H}_6, \text{O}_3$
25. The total number of metals from the given list which will give H_2 on reaction with NaOH is _____.
 $\text{Zn}, \text{Mg}, \text{Al}, \text{Be}$
26. At identical temperature and pressure the rate of diffusion of hydrogen gas is $3\sqrt{3}$ times that of a hydrocarbon having molecular formula $\text{C}_n\text{H}_{2n-2}$. The value of n is _____.

Comprehension Type

Hyperconjugation describes the orbital interaction between π -system and the adjacent σ bond of the substituent group in organic compounds. Thus, the sufficient condition for the hyperconjugation are

- (i) the presence of atleast one sp^2 -hybrid carbon as in alkenes, carbocation and alkyl free radical.
 (ii) the presence of α -carbon, with atleast one hydrogen, with respect of sp^2 -carbon atom.

More the number of hydrogen atoms attached on the α -carbon(s) of the sp^2 -hybrid carbon, more will the hyperconjugation, also called resonating structures of the compound.

Number of resonating structures due to hyperconjugation = $n + 1$, where n is the number of α -hydrogen.

27. Hyperconjugation is possible in
 (a) CH_3^+ (b) $\text{C}_6\text{H}_5\text{CH}_3$
 (c) $\text{CH}_2=\text{CH}_2$ (d) $(\text{CH}_3)_3\text{CC}\equiv\text{CH}$
28. Which of the following has highest number of hyperconjugative structure?
 (a) 2-Ethylbut-2-ene (b) But-2-ene
 (c) *tert*-Butyl cation (d) Hex-2-ene

Matrix Match Type

29. Match the List I with List II and select the correct answer using the code given below the lists :

List I	List II
P. BeO	1. Amphoteric
Q. Al_2O_3	2. Diagonal relationship
R. MgO	3. Quick lime
S. CaO	4. Baryta water
T. BaO	5. Water insoluble
	6. Maximum soluble in water
	7. Estimation by EDTA

P	Q	R	S	T
(a) 5, 2, 1	2, 7, 5	7, 5, 3	5, 2	6, 5, 2
(b) 3, 2, 1	6, 5, 4	1, 2, 3	7, 1, 3	2, 1, 5
(c) 1, 2, 5	1, 2, 5	2, 7	3, 7	4, 6
(d) 3, 4, 1	5, 4, 3	3, 4	7, 2	5, 1, 3

30. Match the thermodynamic processes given under Column I with the expressions given under Column II.

Column I	Column II		
(A) Freezing of water at 273 K and 1 atm	(P) $q = 0$		
(B) Expansion of 1 mol of an ideal gas into a vacuum under isolated conditions	(Q) $w = 0$		
(C) Mixing of equal volumes of two ideal gases at constant temperature and pressure in an isolated container	(R) $\Delta S_{\text{sys}} < 0$		
(D) Reversible heating of $\text{H}_{2(g)}$ at 1 atm from 300 K to 600 K, followed by reversible cooling to 300 K at 1 atm	(S) $\Delta U = 0$		
	(T) $\Delta G = 0$		
A	B	C	D
(a) R, T	P, Q, S	P, Q, S	P, Q, S, T
(b) R, S	P, Q, T	P, Q, T	P, Q, R
(c) R, T	P, Q, S	R, Q, T	P, Q, S, T
(d) R, S	P, Q, R	P, Q, S	P, Q, R



Keys are published in this issue. Search now! ☺

SELF CHECK

No. of questions attempted

No. of questions correct

Marks scored in percentage

Check your score! If your score is

> 90%	EXCELLENT WORK !	You are well prepared to take the challenge of final exam.
90-75%	GOOD WORK !	You can score good in the final exam.
74-60%	SATISFACTORY !	You need to score more next time.
< 60%	NOT SATISFACTORY!	Revise thoroughly and strengthen your concepts.

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- What is the value of $\lambda_{\text{ClCH}_2\text{COOH}}^\circ$?
Given : $\lambda_{\text{ClCH}_2\text{COONa}}^\circ = 224 \text{ ohm}^{-1} \text{ cm}^2 \text{ g eq}^{-1}$,
 $\lambda_{\text{NaCl}}^\circ = 38.2 \text{ ohm}^{-1} \text{ cm}^2 \text{ g eq}^{-1}$,
 $\lambda_{\text{HCl}}^\circ = 203 \text{ ohm}^{-1} \text{ cm}^2 \text{ g eq}^{-1}$,
(a) $288.5 \text{ ohm}^{-1} \text{ cm}^2 \text{ g eq}^{-1}$,
(b) $289.5 \text{ ohm}^{-1} \text{ cm}^2 \text{ g eq}^{-1}$
(c) $388.8 \text{ ohm}^{-1} \text{ cm}^2 \text{ g eq}^{-1}$
(d) $59.5 \text{ ohm}^{-1} \text{ cm}^2 \text{ g eq}^{-1}$
- In the reaction
$$\text{HC}\equiv\text{CH} \xrightarrow[\text{dil. H}_2\text{SO}_4]{\text{HgSO}_4} \text{X} \xrightarrow{\text{LiAlH}_4} \text{Y} \xrightarrow{\text{Red P; Br}_2} \text{Z}$$

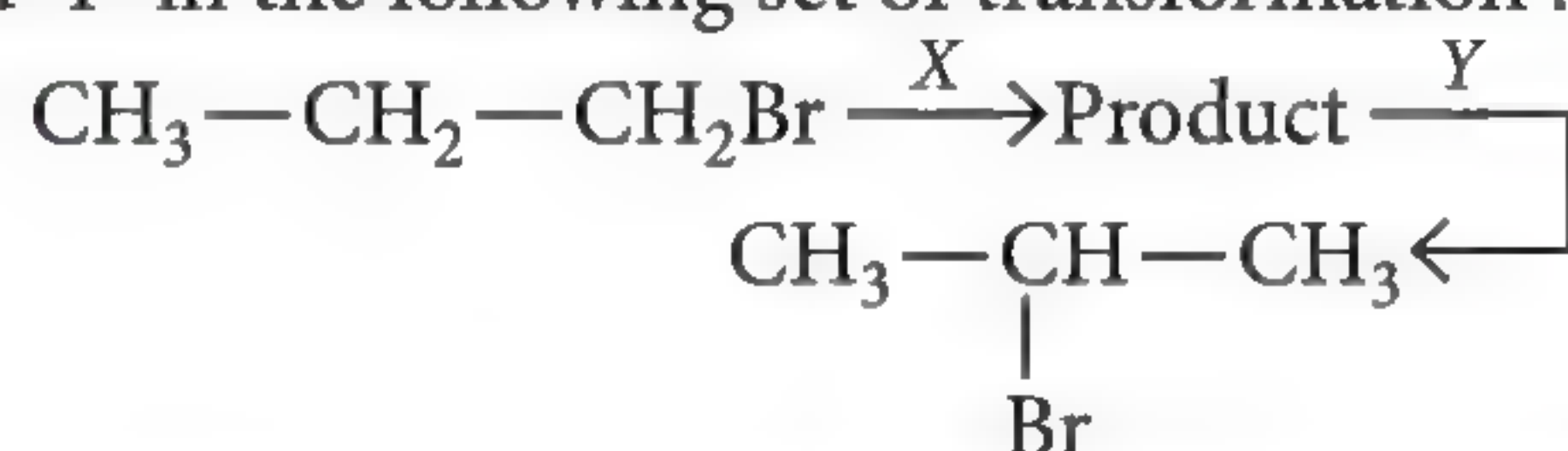
Z is
(a) ethylidene bromide (b) ethyl bromide
(c) bromobenzene (d) ethylene bromide.
- What would happen when a solution of potassium chromate is treated with an excess of dilute nitric acid?
(a) Cr^{3+} and $\text{Cr}_2\text{O}_7^{2-}$ are formed.
(b) $\text{Cr}_2\text{O}_7^{2-}$ and H_2O are formed.
(c) CrO_4^{2-} is reduced to +3 state of Cr.
(d) CrO_4^{2-} is oxidised to +7 state of Cr.
- Nylon-6, 6 is obtained from
(a) hexamethylenediamine and adipic acid
(b) phenol and formaldehyde
(c) propylene and adipic acid
(d) adipic acid and phthalic acid.
- During micelle formation
(a) $\Delta H = +\text{ve}$, $\Delta S = -\text{ve}$
(b) $\Delta H = -\text{ve}$, $\Delta S = -\text{ve}$
(c) $\Delta H = +\text{ve}$, $\Delta S = +\text{ve}$
(d) $\Delta H = -\text{ve}$, $\Delta S = +\text{ve}$
- A coordination complex compound of cobalt has molecular formula containing five ammonia molecules, one nitro group and two chlorine atoms for one cobalt atom. One mole of this compound produces three moles of ions in aqueous solution. On reacting this solution with excess of silver nitrate solutions, two moles of AgCl get precipitated. The ionic formula of this complex would be
(a) $[\text{Co}(\text{NH}_3)_4(\text{NO}_2)\text{Cl}](\text{NH}_3)\text{Cl}$
(b) $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}(\text{NO}_2)$
(c) $[\text{Co}(\text{NH}_3)_5(\text{NO}_2)]\text{Cl}_2$
(d) $[\text{Co}(\text{NH}_3)_5](\text{NO}_2)_2\text{Cl}_2$
- The bond that determines the secondary structure of protein is
(a) covalent bond (b) sulphur linkage
(c) hydrogen bond (d) ionic bond.

8. ClO_2 reacts with NaOH to give a mixture of
 (a) NaClO_2 and NaClO_4
 (b) NaClO_2 and NaClO_3
 (c) NaClO and NaClO_2
 (d) NaClO_3 and NaClO_4
9. Match Column I with Column II and select the correct option.

Column I	Column II
(A) Cyanide process	(i) Ultra pure Ge
(B) Froth Floatation process	(ii) Pine oil
(C) Electrolytic refining	(iii) Extraction of Al
(D) Zone refining	(iv) Extraction of Au
(a) (A)-(iii), (B)-(i), (C)-(iv), (D)-(ii)	
(b) (A)-(iv), (B)-(ii), (C)-(iii), (D)-(i)	
(c) (A)-(iii), (B)-(ii), (C)-(iv), (D)-(i)	
(d) (A)-(iv), (B)-(i), (C)-(iii), (D)-(ii)	

10. A solid A^+B^- has NaCl type close packed structure. The radius of the cation, when the radius of the anion is 250 pm, is
 (a) 103.5 pm (b) 207 pm
 (c) 69 pm (d) 276 pm

11. Identify the set of reagents/reaction conditions 'X' and 'Y' in the following set of transformation :

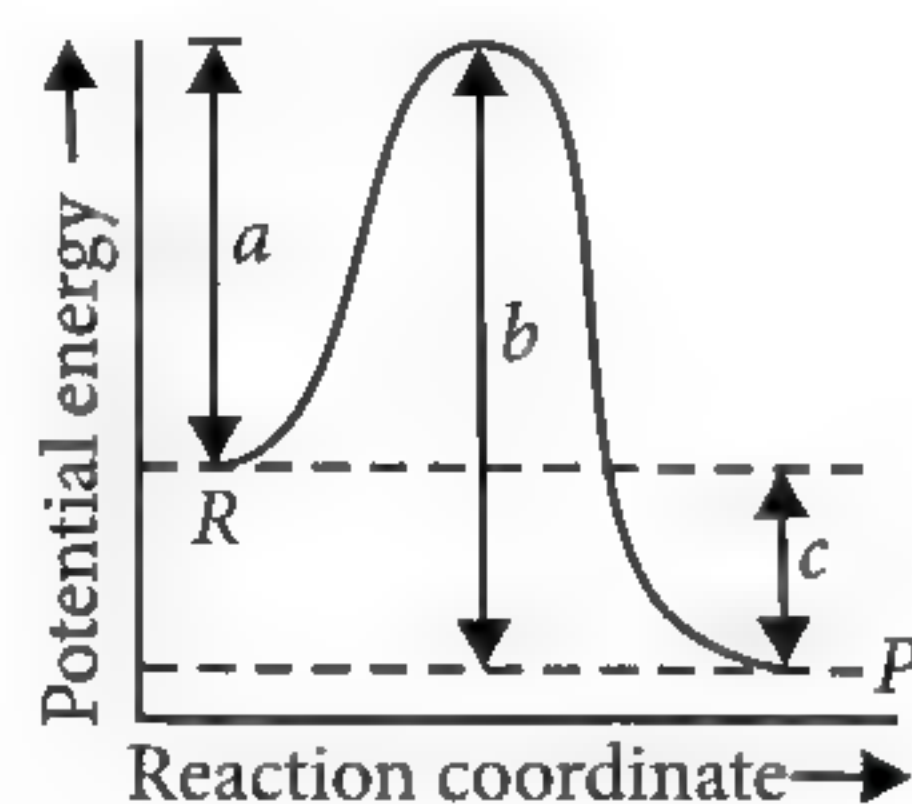


- (a) X = concentrated alcoholic NaOH solution, 80°C ;
 Y = HBr /acetic acid at 20°C
 (b) X = dilute aqueous NaOH , 20°C ;
 Y = HBr /acetic acid at 20°C
 (c) X = dilute aqueous NaOH , 20°C ;
 Y = $\text{Br}_2/\text{CHCl}_3$, 0°C
 (d) X = concentrated alcoholic NaOH , 80°C ;
 Y = $\text{Br}_2/\text{CHCl}_3$, 0°C

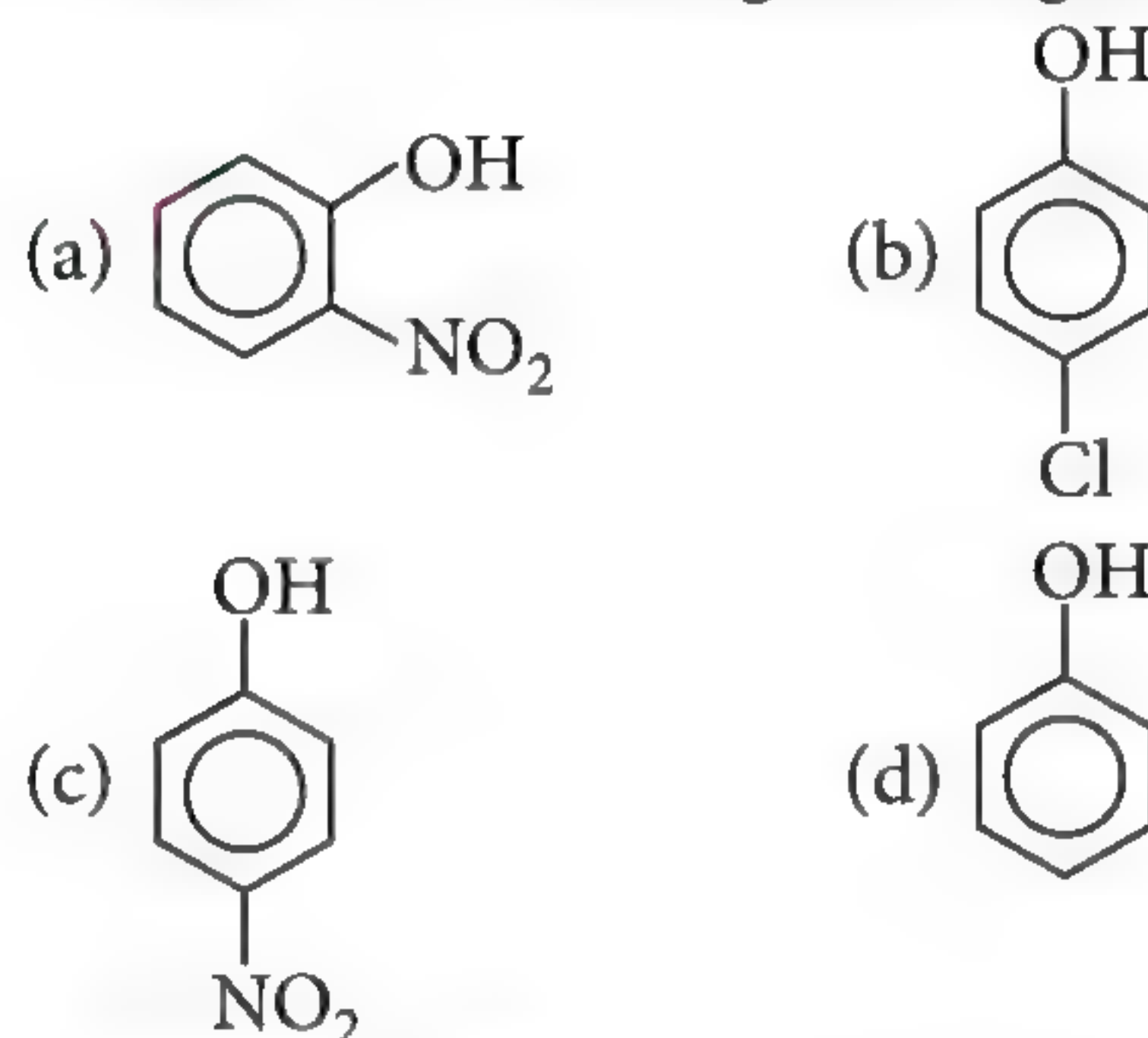
12. The potential energy diagram for the reaction $R \longrightarrow P$ is as given :

ΔH° of the reaction corresponds to the energy

- (a) a
 (b) b
 (c) c
 (d) a + b



13. Which of the following is strongest acid?



14. Which of the following liquid pairs shows a positive deviation from Raoult's law?

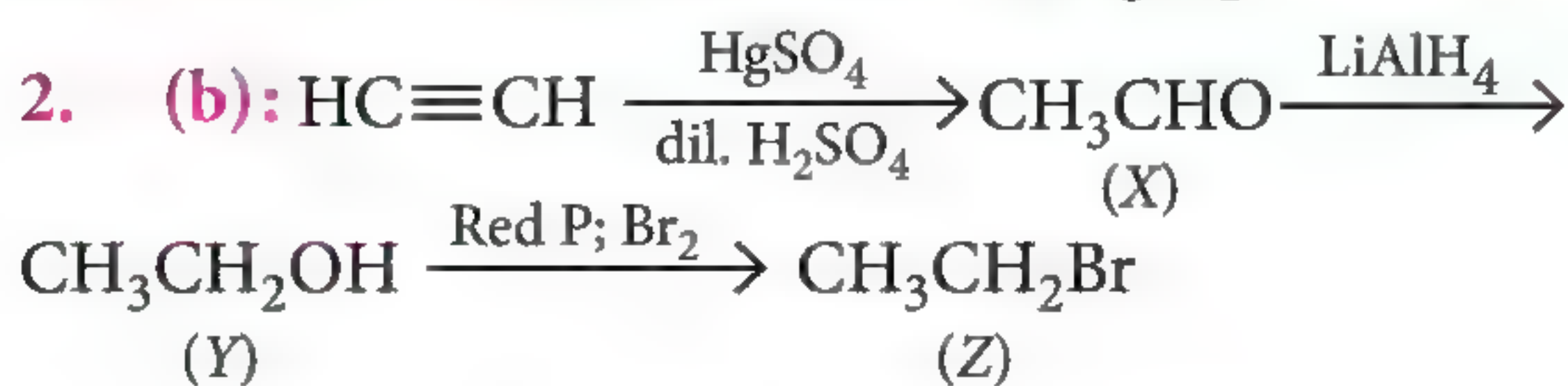
- (a) Water - hydrochloric acid
 (b) Benzene - methanol
 (c) Water - nitric acid
 (d) Acetone - chloroform

15. The compound $\text{C}_5\text{H}_{13}\text{N}$ is optically active and reacts with HONO to give $\text{C}_5\text{H}_{11}\text{OH}$. The compound is

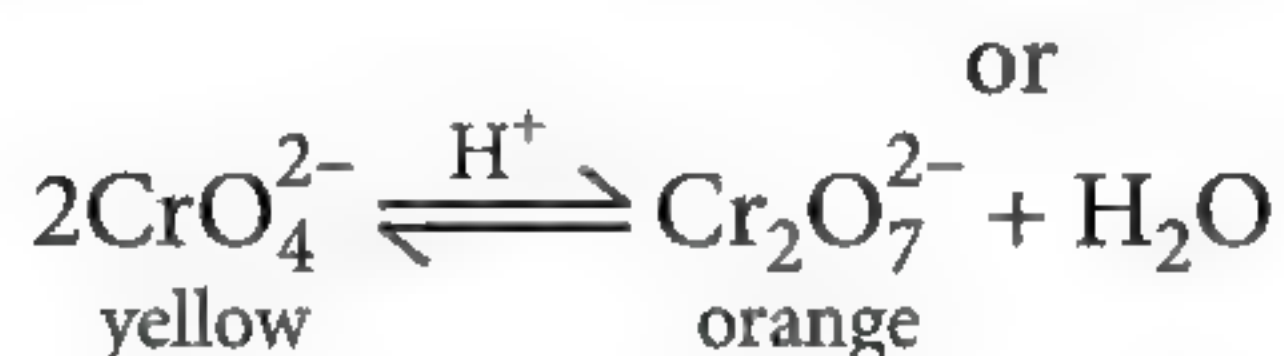
- (a) *N*-methylbutanamine
 (b) 2-aminopentane
 (c) 1-aminopentane
 (d) *N, N'*-dimethylpropanamine.

SOLUTIONS

1. (c): $\lambda_{\text{ClCH}_2\text{COOH}}^\circ = \lambda_{\text{ClCH}_2\text{COO}^-}^\circ + \lambda_{\text{H}^+}^\circ - \lambda_{\text{NaCl}}^\circ$
 $224 + 203 - 38.2 = 388.8 \text{ ohm}^{-1} \text{ cm}^2 \text{ g eq}^{-1}$



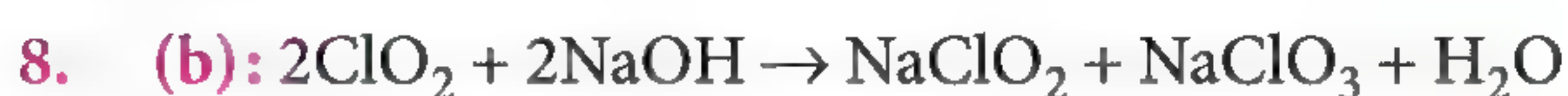
3. (b): Dilute nitric acid reacts with potassium chromate to form potassium dichromate and H_2O .



4. (a) 5. (c)

6. (c): Since one mole of compound produces three moles of ions, there must be two ions outside the coordination sphere. Since two Cl-atoms are ionizable, the probable formula of the compound is $[\text{Co}(\text{NH}_3)_5(\text{NO}_2)]\text{Cl}_2$.

7. (c)



9. (b): Cyanide process – Extraction of Au
 Froth floatation process – Pine oil
 Electrolytic refining – Extraction of Al
 Zone refining – Ultra pure Ge

10. (a): Since the solid A^+B^- has NaCl type close packed structure, it belongs to a system with coordination number 6. In these cases the ratio of the cation to the anion radii is given by

$$(r^+/r^-) \geq 0.414$$

Now $r^- = 250 \text{ pm}$

$$\therefore r^+ = 250 \times 0.414 = 103.5 \text{ pm}$$

11. (a)

12. (c): ΔH° of the reaction is the difference of energy of products and reactants.

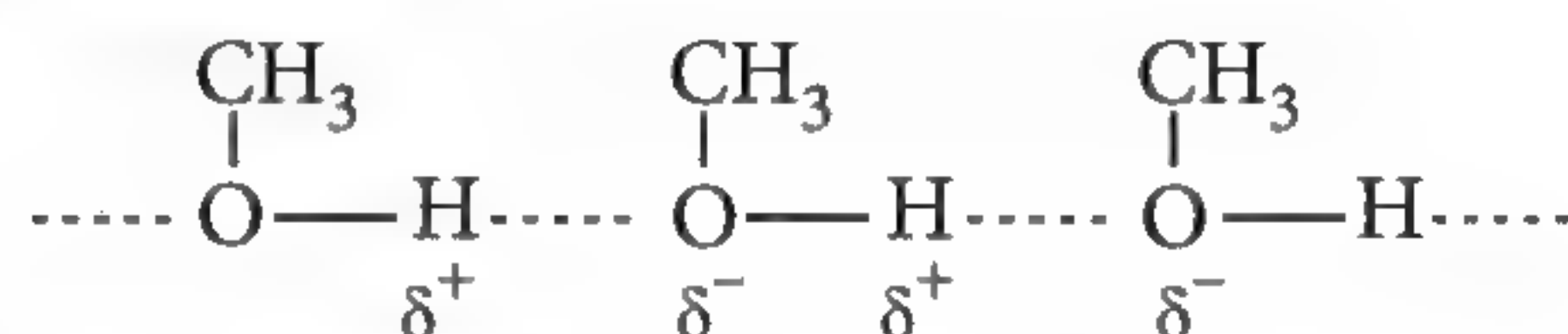
13. (c): The correct acidity order is:

p -nitrophenol > o -nitrophenol >

p -chlorophenol > phenol.

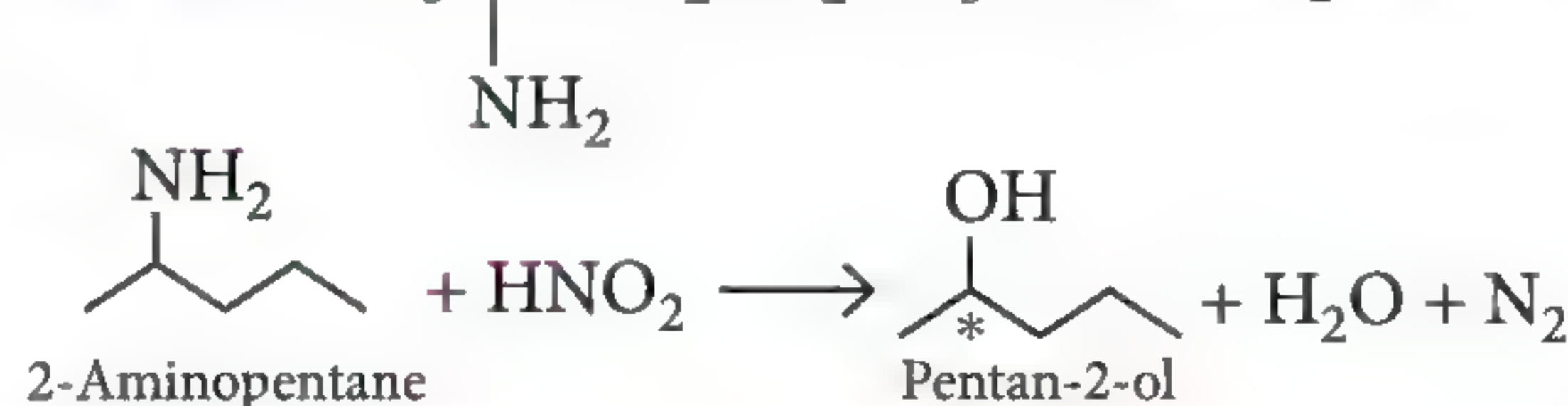
14. (b): In solutions showing positive deviation, the observed vapour pressure of each component and total vapour pressure are greater than predicted by Raoult's law, i.e., $p_A > p_A^\circ x_A$; $p_B > p_B^\circ x_B$; $P_{\text{total}} > p_A + p_B$

In solution of methanol and benzene, methanol molecules are held together due to hydrogen bonding as shown below:

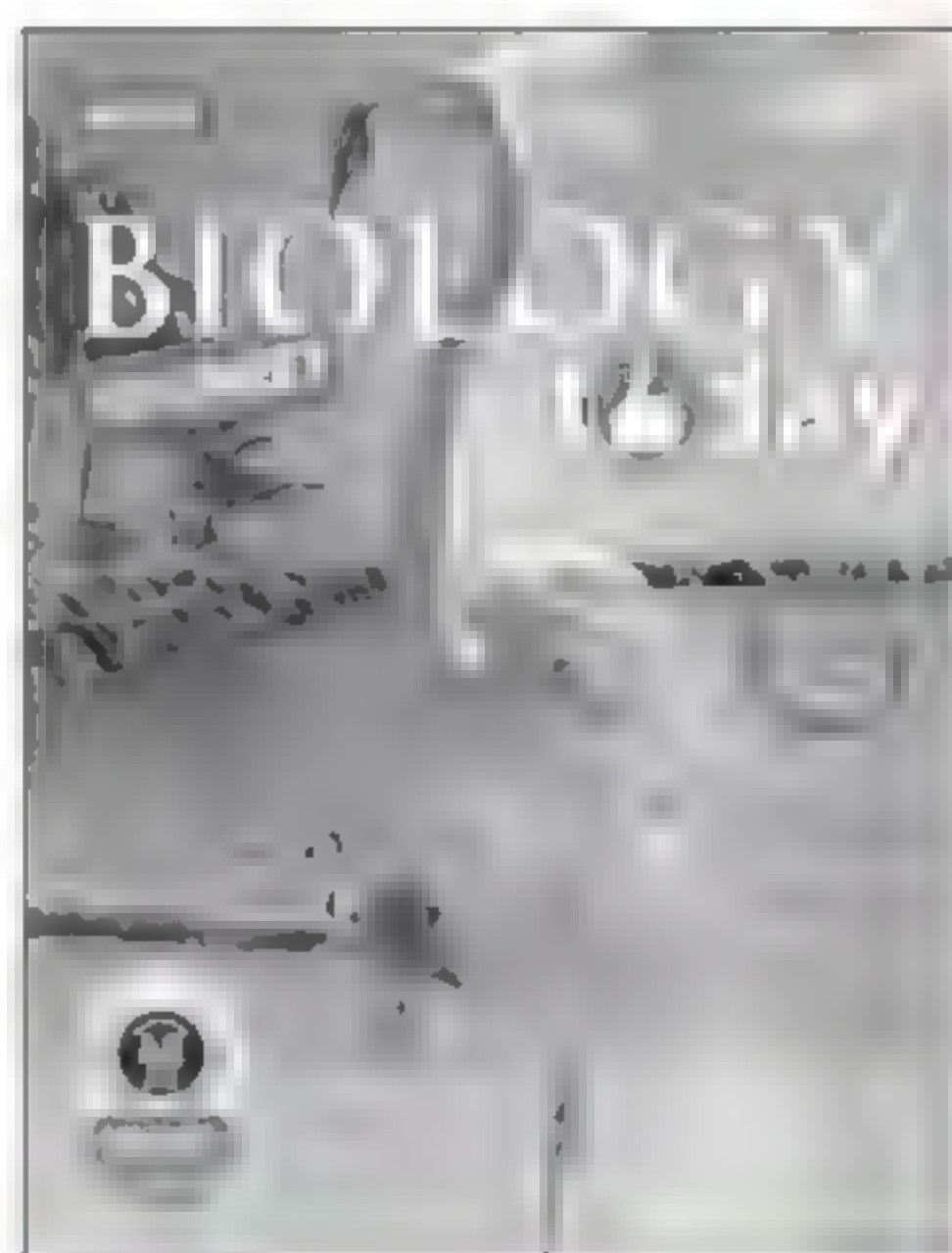
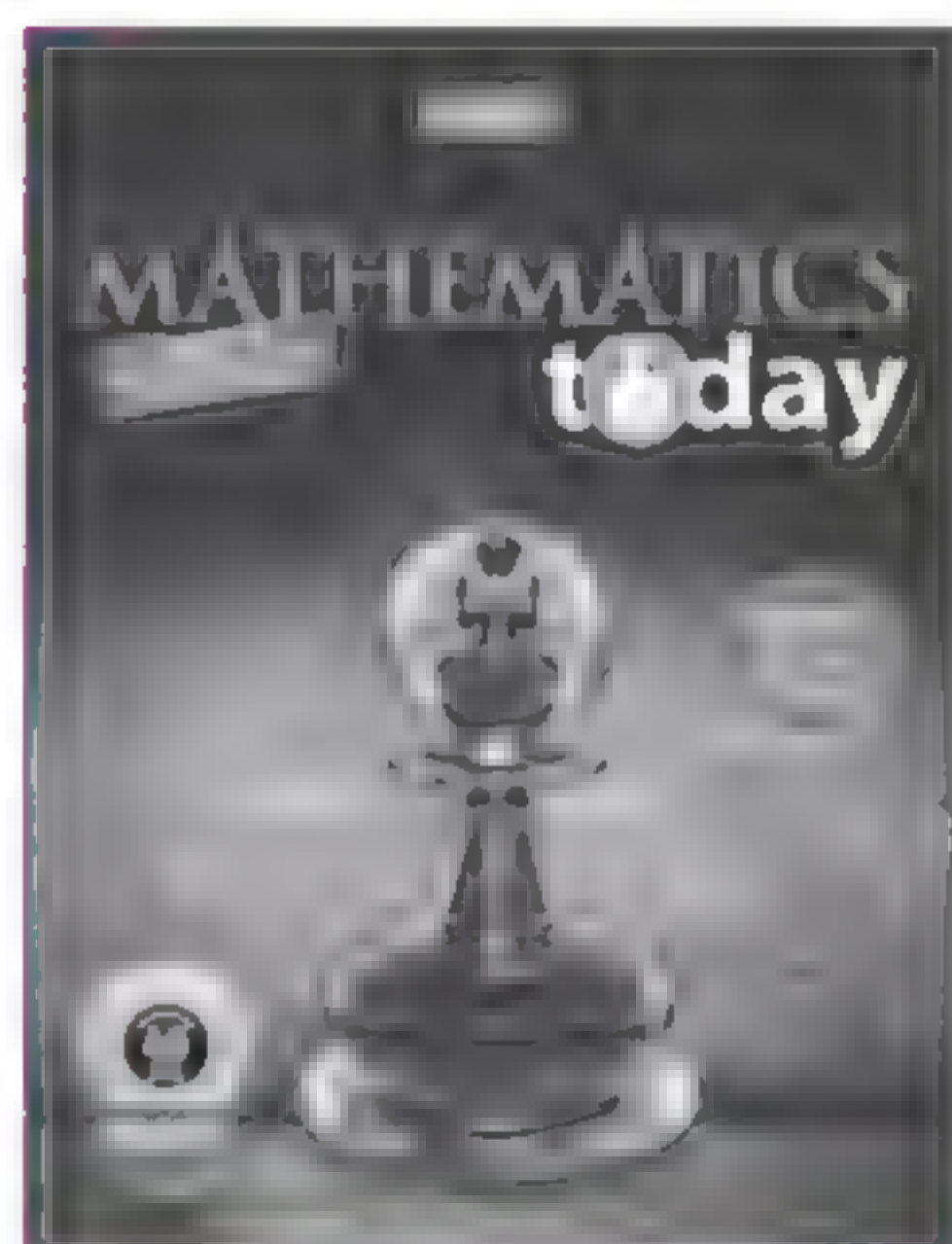
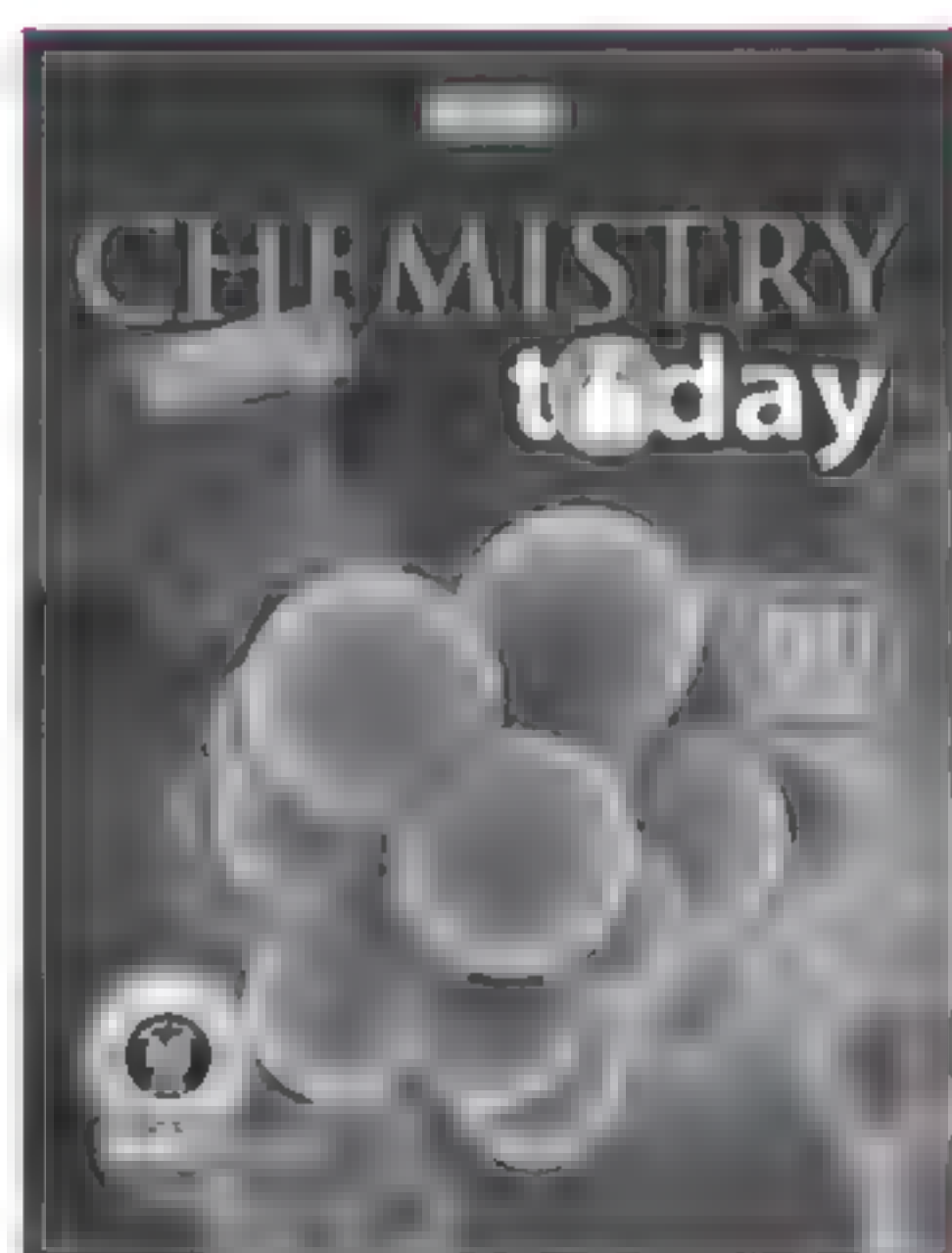
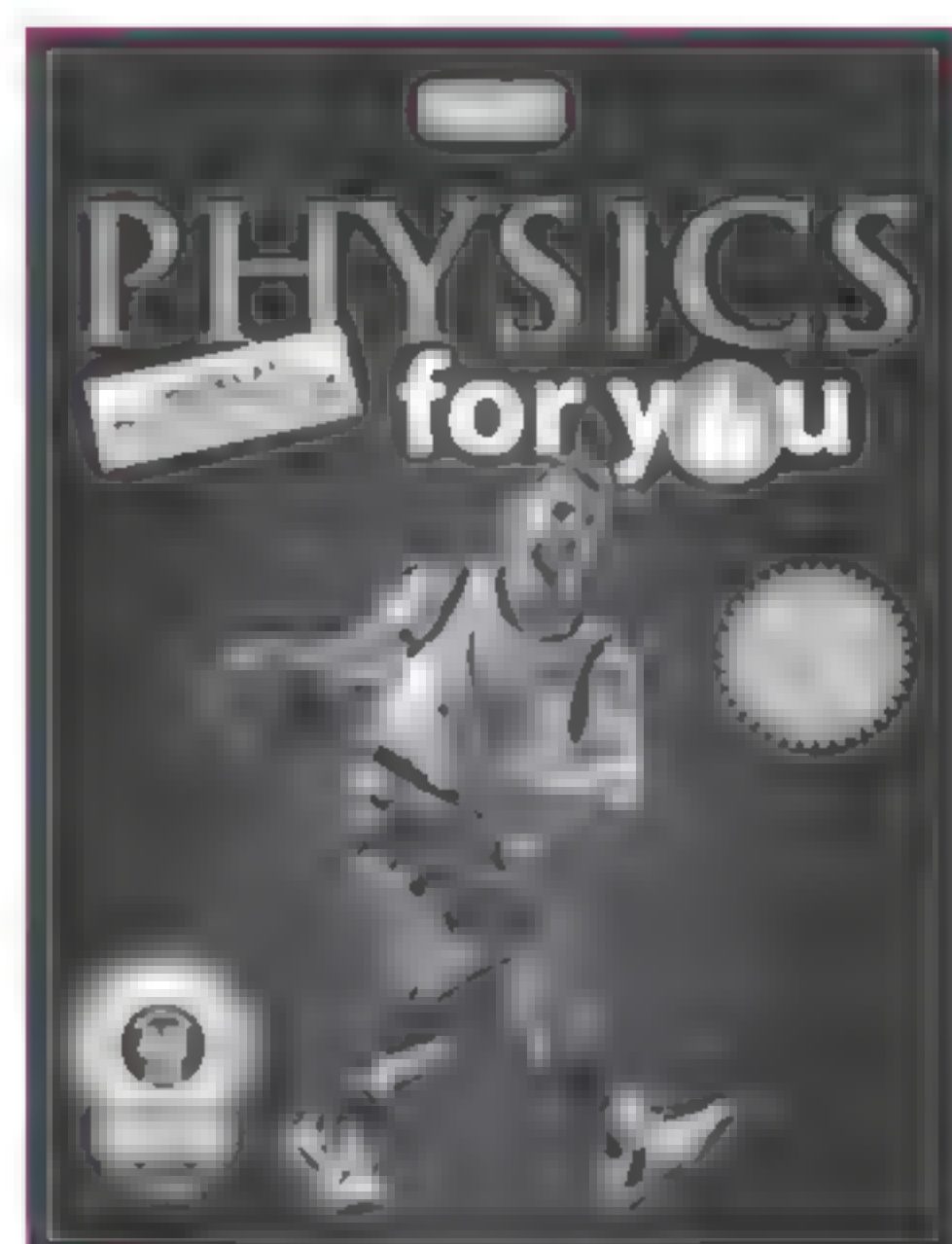


On adding benzene, the benzene molecules get in between the molecules of methanol, thus breaking the hydrogen bonds. As the resulting solution has weaker intermolecular attractions, the escaping tendency of alcohol and benzene molecules from the solution increases. Consequently the vapour pressure of the solution is greater than the vapour pressure as expected from Raoult's law.

15. (b): $\text{CH}_3 \overset{*}{\text{CH}}\text{CH}_2\text{CH}_2\text{CH}_3$ (2-Aminopentane)



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MONTHLY TEST DRIVE

Practice Paper



This specially designed column enables students to self analyse their extent of understanding the complete syllabus. Give yourself four marks for each correct answer and deduct one mark for each wrong answer. Self check table given at the end will help you to check your readiness.

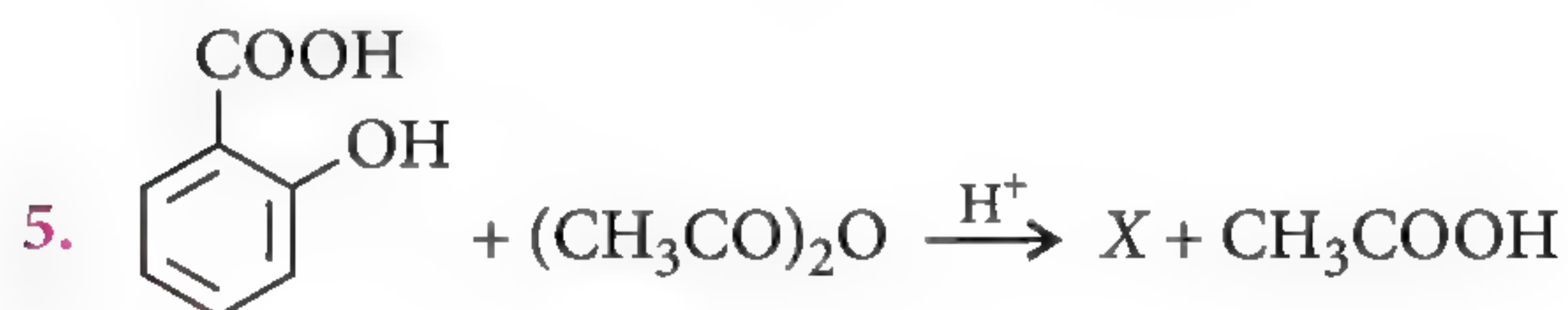
Total Marks : 120

Time Taken : 60 Min.

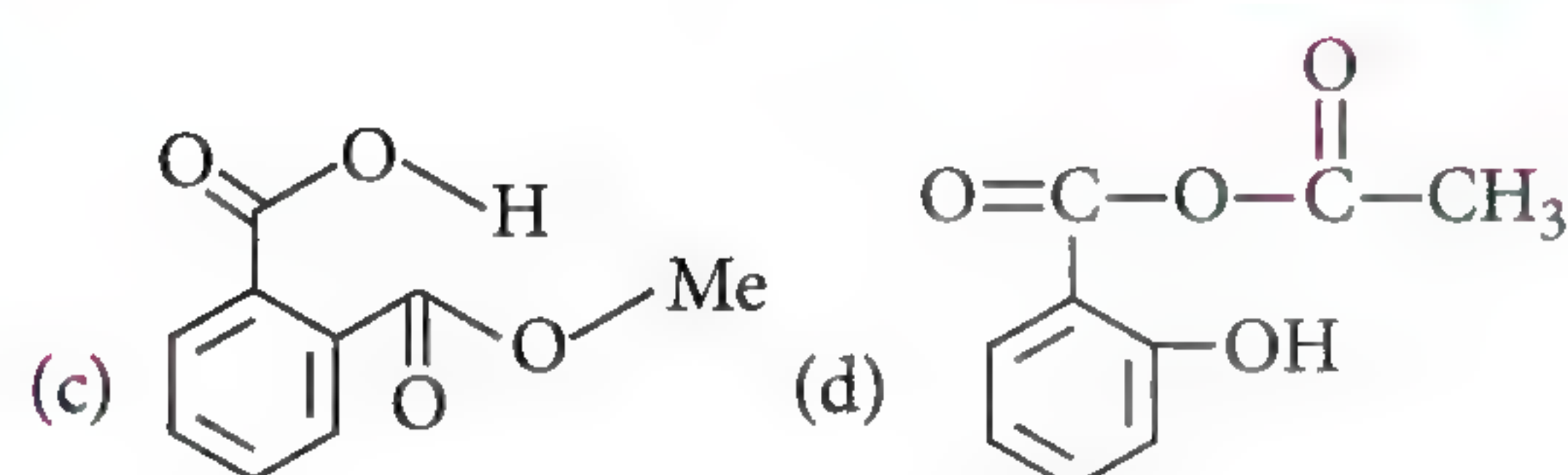
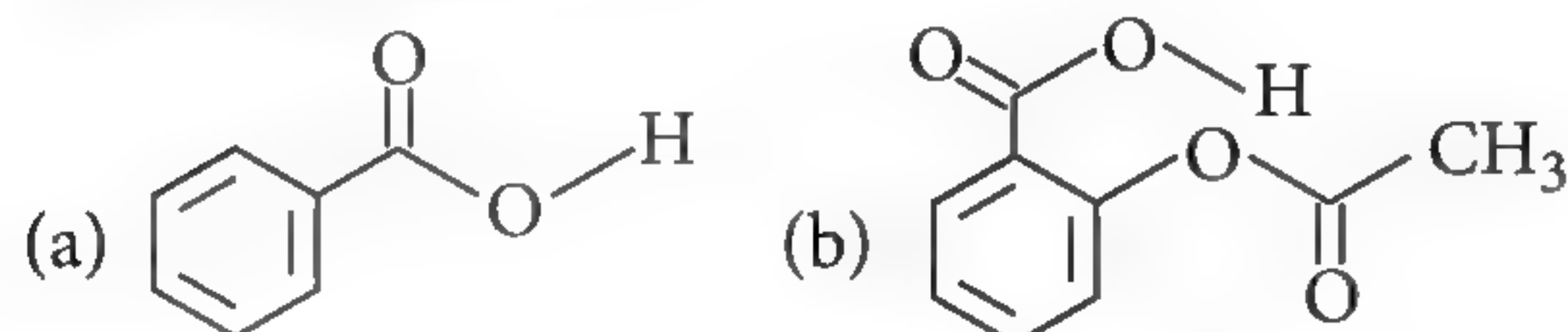
NEET

Only One Option Correct Type

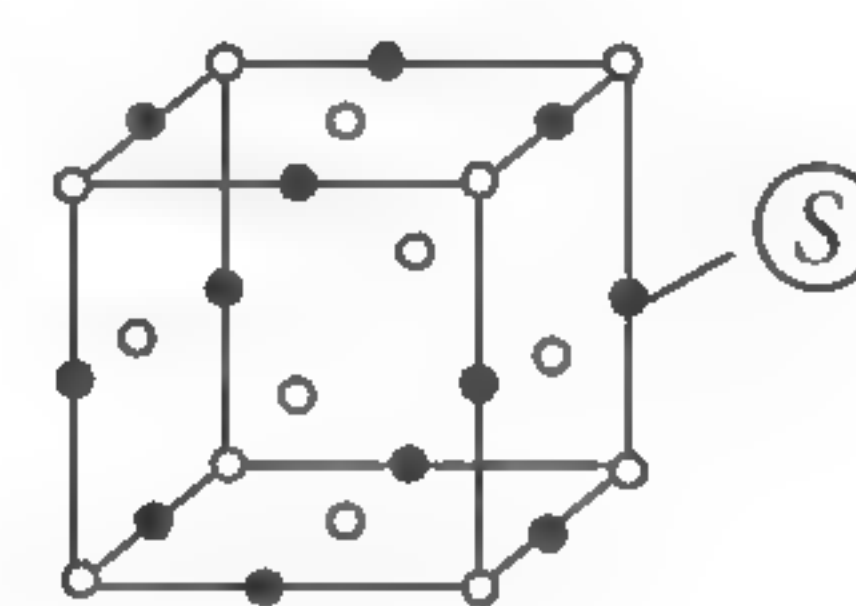
- An organic compound with the formula $C_6H_{12}O_6$ forms a yellow crystalline solid with phenylhydrazine and gives a mixture of sorbitol and mannitol when reduced with sodium. Which among the following could be the compound?
(a) Fructose (b) Glucose
(c) Mannose (d) Sucrose
- In order to convert aniline into chlorobenzene, the reagent used is
(a) $NaNO_2/HCl$, $CuCl$ (b) Cl_2/CCl_4
(c) $Cl_2/AlCl_3$ (d) $CuCl_2$
- Solid XeF_6 exists as
(a) XeF_4^+ and F_2^- (b) XeF_5^+ and F^-
(c) XeF_7^- and F^+ (d) Xe^{4+} and F^{4-}
- Which of the following sets of reactants is used for the preparation of paracetamol from phenol?
(a) HNO_3 , H_2/Pd , $(CH_3CO)_2O$
(b) H_2SO_4 , H_2/Pd , $(CH_3CO)_2O$
(c) $C_6H_5N_2Cl$, $SnCl_2/HCl$, $(CH_3CO)_2O$
(d) Br_2/H_2O , Zn/HCl , $(CH_3CO)_2O$



The compound 'X' is

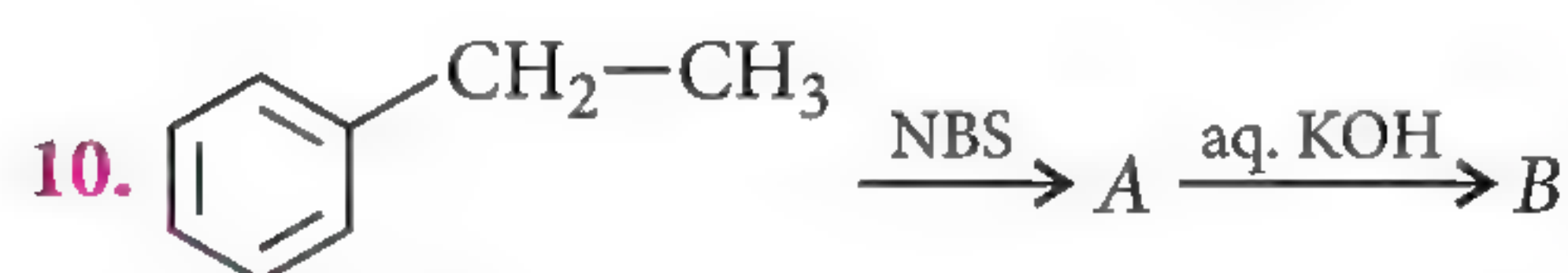


- One mole of a complex compound $Co(NH_3)_5Cl_3$ gives 3 moles of ions when dissolved in water. One mole of the same complex reacts with two moles of $AgNO_3$ solution to form two moles of $AgCl$. The structure of complex is
(a) $[Co(NH_3)_5Cl]Cl_2$
(b) $[Co(NH_3)_3Cl_3].2NH_3$
(c) $[Co(NH_3)_4Cl_2]Cl.NH_3$
(d) none of these.
- For the given structure, the site marked as S is a
(a) tetrahedral void
(b) cubic void
(c) octahedral void
(d) none of these.
- Which of the following factors is of no significance for roasting sulphide ores to the oxides and not subjecting the sulphide ores to carbon reduction directly?
(a) CO_2 is more volatile than CS_2 .
(b) Metal sulphides are thermodynamically more stable than CS_2 .
(c) CO_2 is thermodynamically more stable than CS_2 .
(d) Metal sulphides are less stable than the corresponding oxides.

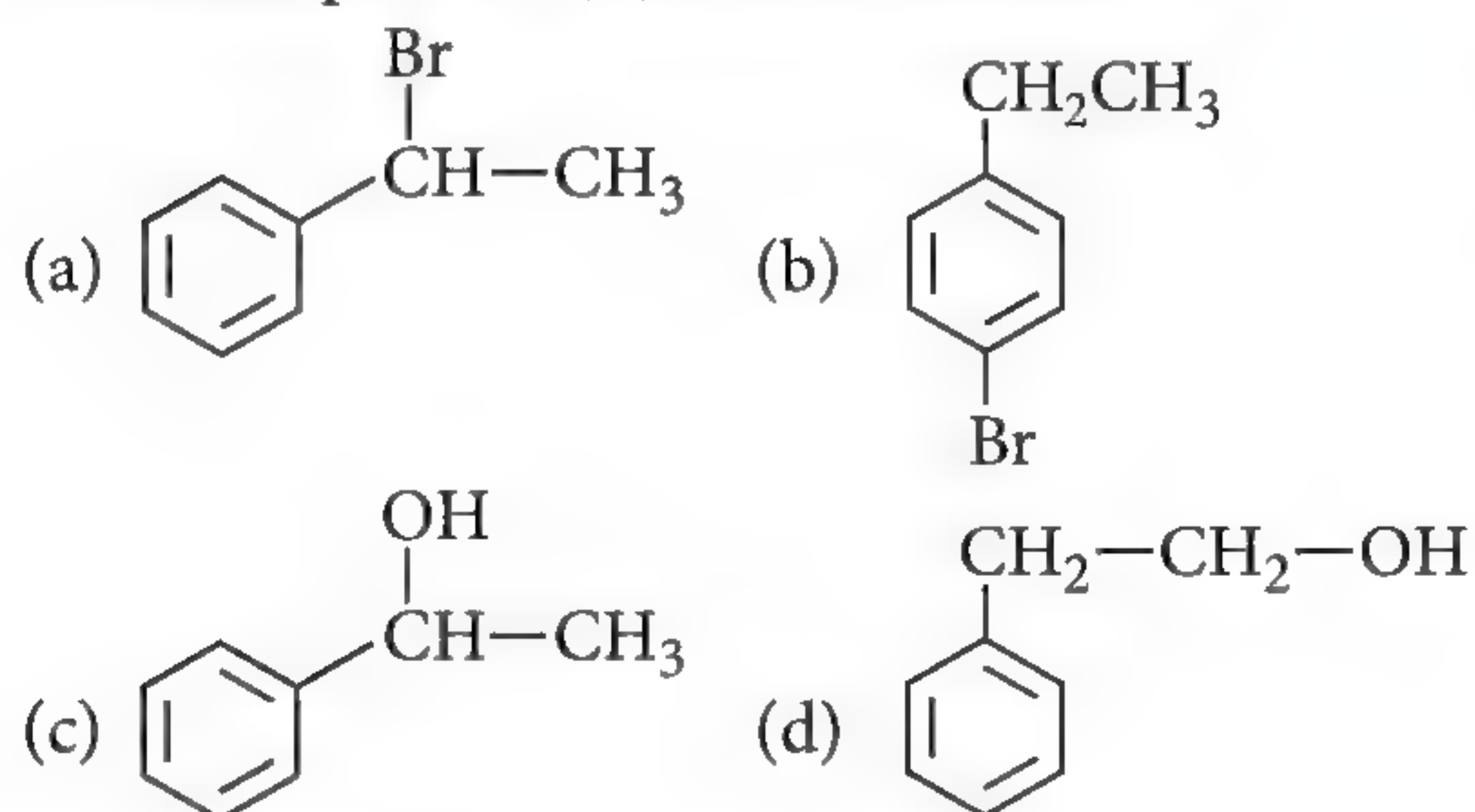


9. The volume of a colloidal particle, V_c as compared to the volume of a solute particle in a true solution V_s could be

(a) ~ 1 (b) $\sim 10^{23}$
(c) $\sim 10^{-3}$ (d) $\sim 10^3$



The main product (B) of the reaction is :



11. If a solution containing components A and B follows Raoult's law then

(a) A—B attraction force is greater than A—A and B—B
(b) A—B attraction force is less than A—A and B—B
(c) A—B attraction force remains same as A—A and B—B
(d) volume of solution is different from sum of volumes of solute and solvent.

12. An explosion takes place when conc. H_2SO_4 is added to KMnO_4 . Which of the following is formed?

(a) Mn_2O_7 (b) MnO_2
(c) MnSO_4 (d) Mn_2O_3

Assertion & Reason Type

Directions : In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as :

- (a) If both assertion and reason are true and reason is the correct explanation of assertion.
(b) If both assertion and reason are true but reason is not the correct explanation of assertion.
(c) If assertion is true but reason is false.
(d) If both assertion and reason are false.

13. **Assertion :** Olefinic monomers undergo addition polymerisation.

Reason : Polymerisation of vinyl chloride is initiated by peroxides/persulphates.

14. **Assertion :** $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ is coloured while $[\text{Sc}(\text{H}_2\text{O})_6]^{3+}$ is colourless.

Reason : $d-d$ transition is not possible in $[\text{Sc}(\text{H}_2\text{O})_6]^{3+}$.

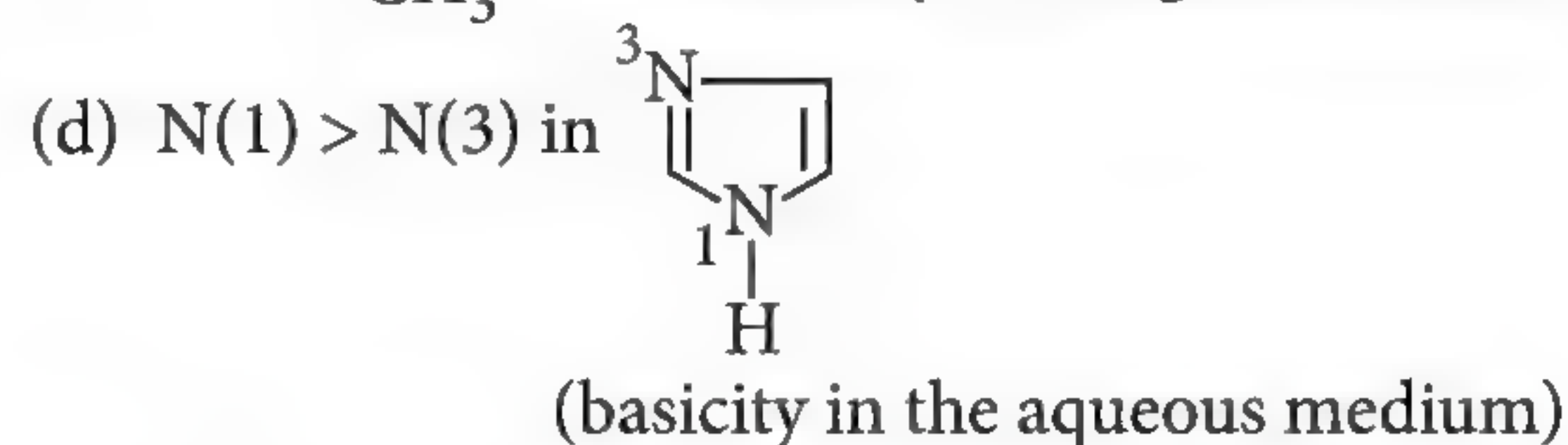
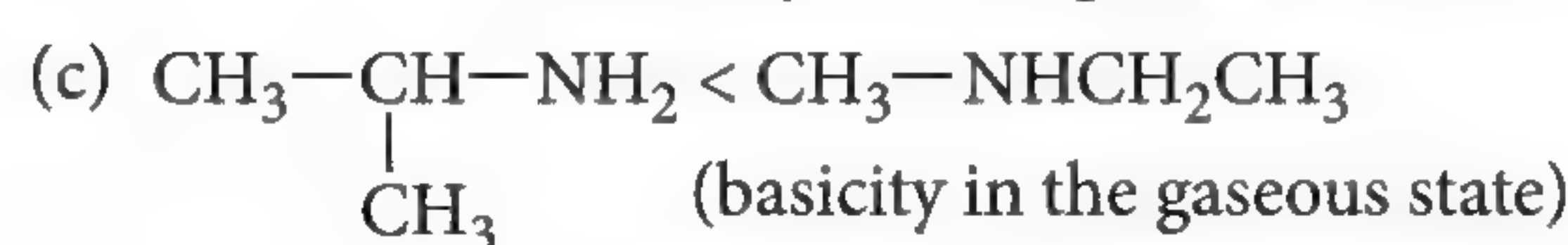
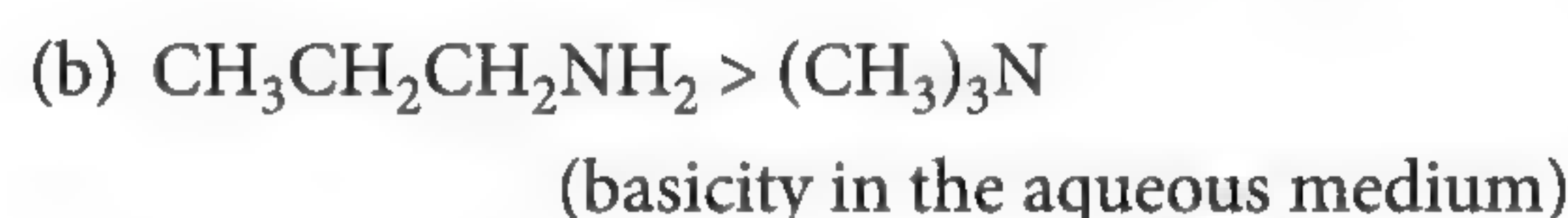
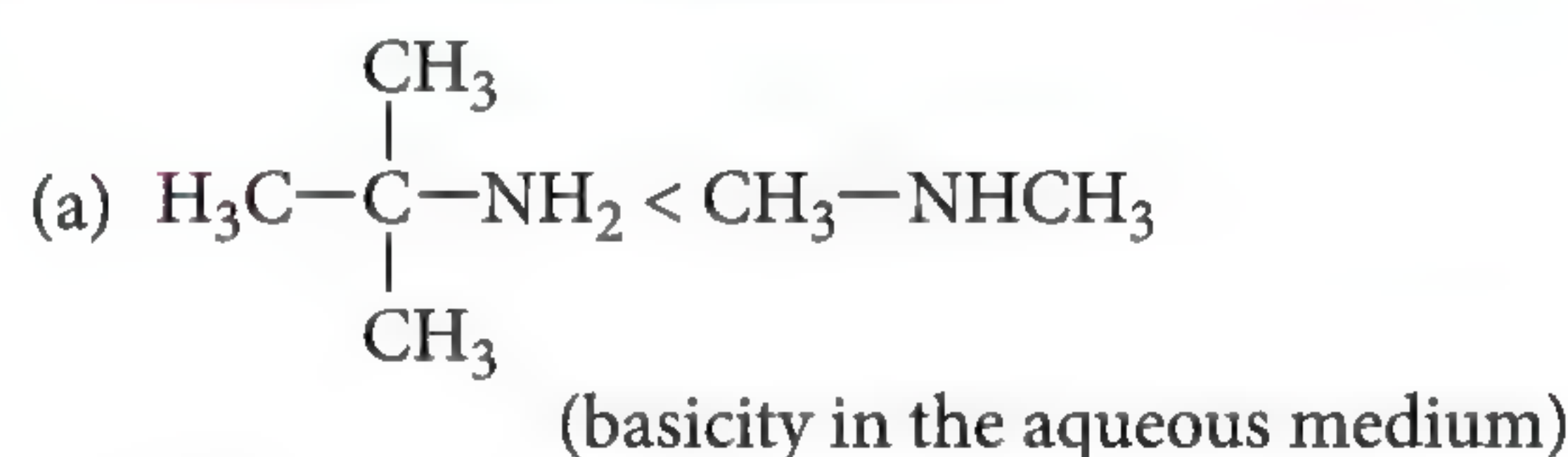
15. **Assertion :** ZnO turns yellow on heating.

Reason : This is due to the presence of extra cations at interstitial sites, known as metal excess defects.

JEE MAIN / JEE ADVANCED

Only One Option Correct Type

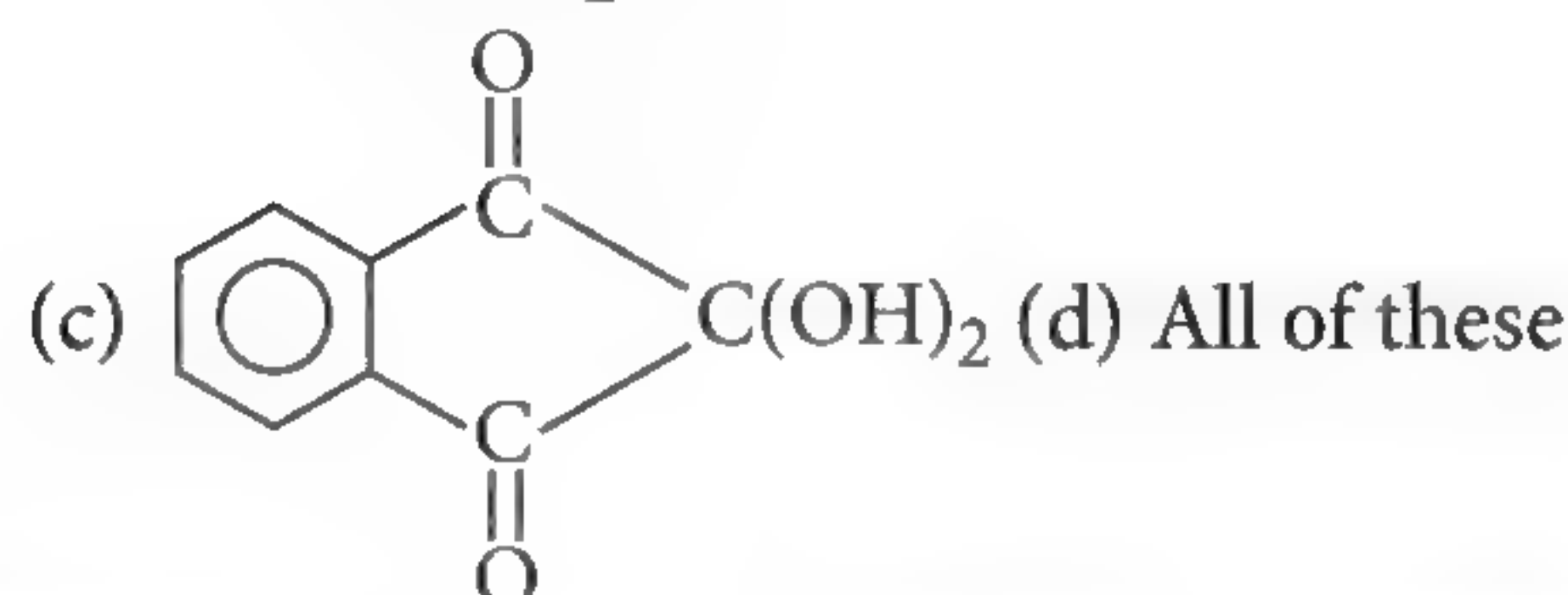
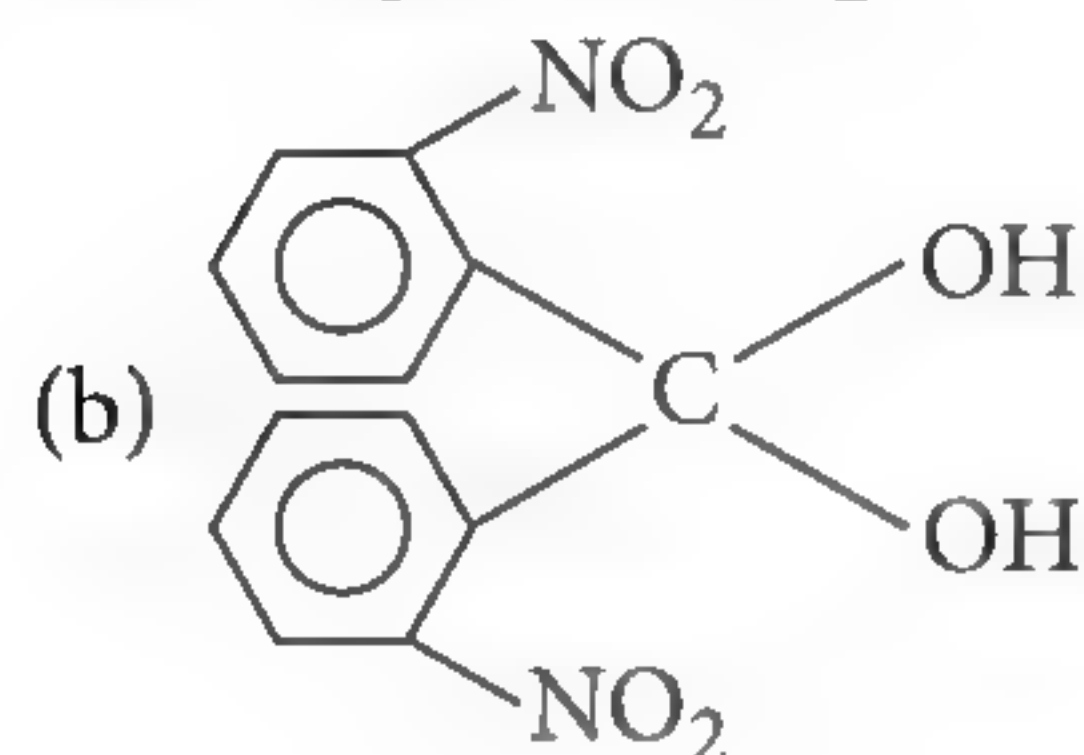
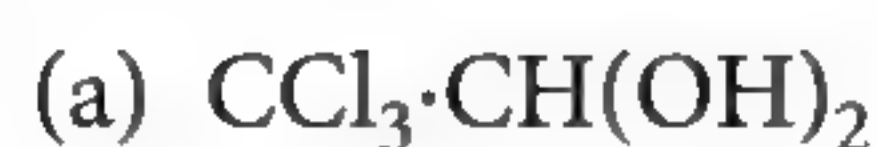
16. Choose the incorrect comparison.



17. Presence of two or three 'OH' groups on one C-atom causes unstability. Still, some such compounds are stable. Which of the following is/are stable?

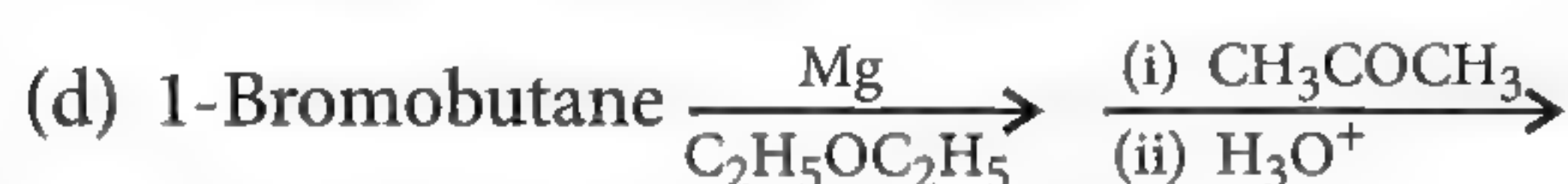
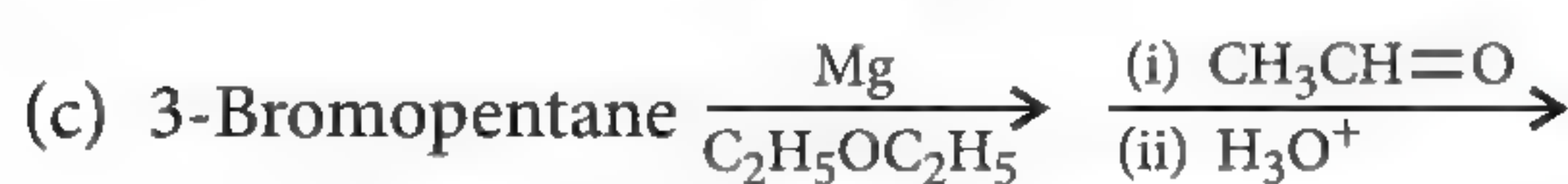
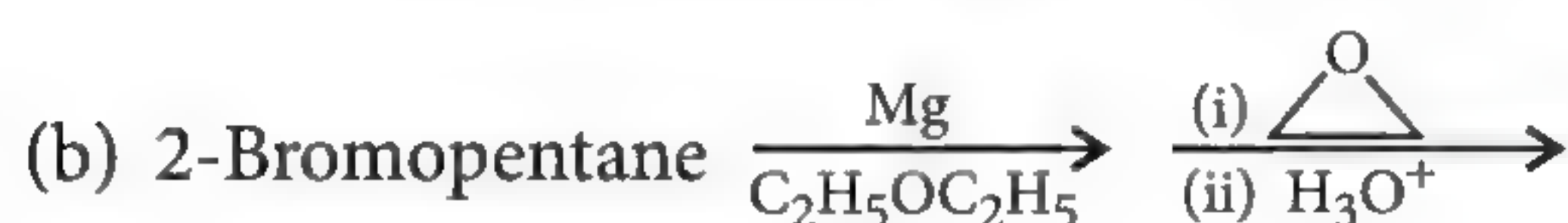
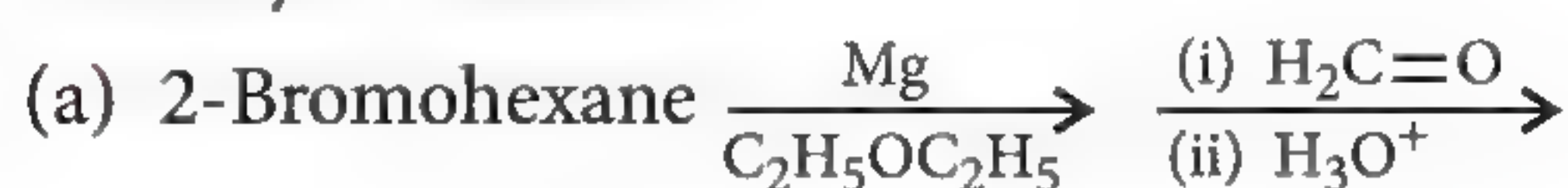
EXAM ALERT 2022

Exam	Date
JEE Main	Session 1: 20 th to 29 th June Session 2: 21 st to 30 th July
BITSAT	Session-I: 20 th to 26 th June Session-II: 22 nd to 26 th July
COMEDK	19 th June
SRMJEEE	Phase 3 : 25 th and 26 th June
KEAM	3 rd July
VITEEE	30 th June to 6 th July
NEET	17 th July
JEE Advanced	28 th August



(d) All of these

18. Which of the following synthesis gives 3-methyl-1-hexanol?



19. The emf of a Daniell cell at 298 K is E_1
 $\text{Zn} | \text{ZnSO}_4(0.01 \text{ M}) || \text{CuSO}_4(1.0 \text{ M}) | \text{Cu}$
 When the concentration of ZnSO_4 is 1.0 M and that of CuSO_4 is 0.01 M, the emf is changed to E_2 .
 What is the relationship between E_1 and E_2 ?

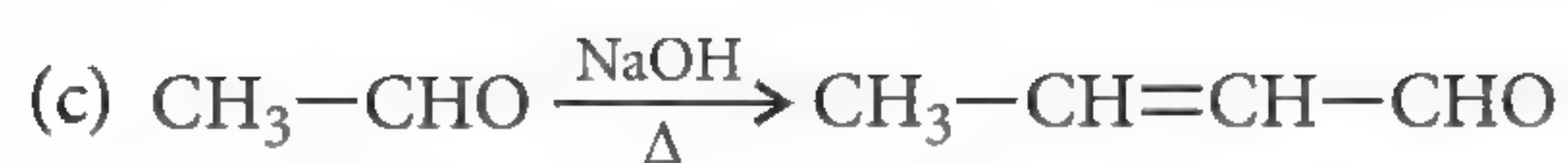
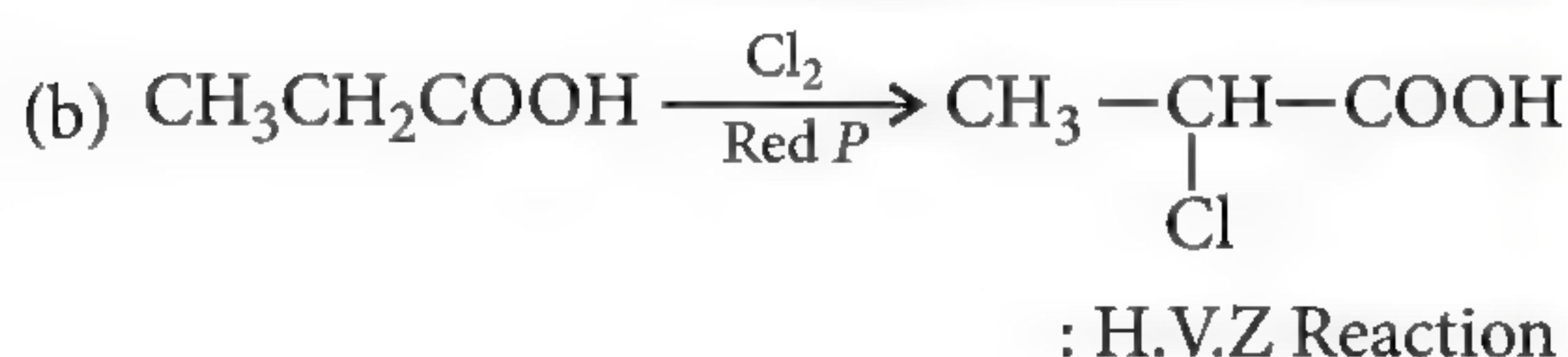
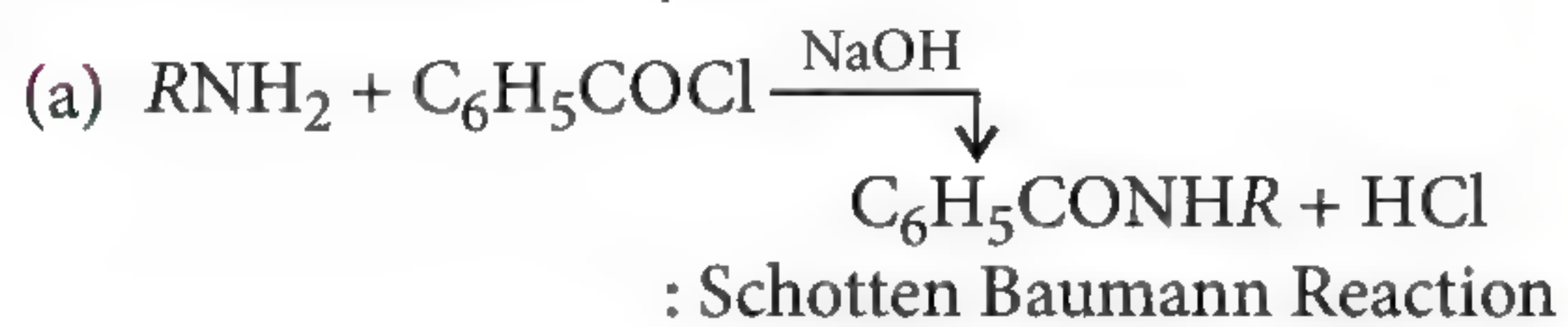
- (a) $E_2 = 0 \approx E_1$ (b) $E_1 > E_2$
 (c) $E_1 < E_2$ (d) $E_1 = E_2$

More than One Option Correct Type

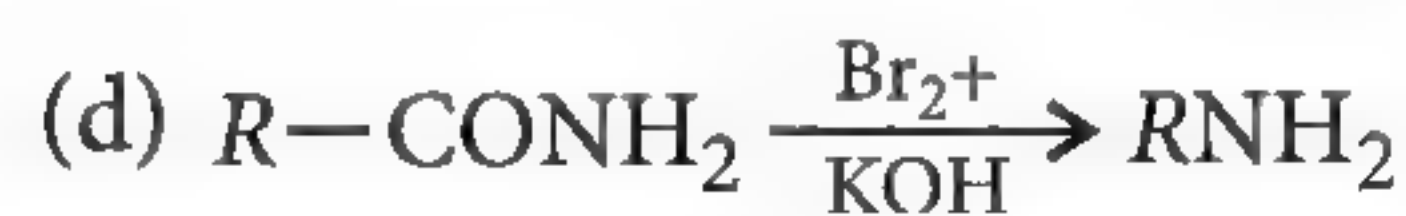
20. Which of the following statements are correct about barbiturates?

- (a) They are hypnotics or sleep inducing agents.
 (b) They are tranquilizers.
 (c) They are non-narcotic analgesics.
 (d) They reduce pain without disturbing the nervous system.

21. Which is/are correctly matched?



: Cannizzaro Reaction



: Hoffmann Bromamide degradation

22. Which of the following options are correct?

- (a) Cast iron is obtained by remelting pig iron with scrap iron and coke using hot air blast.
 (b) In extraction of silver, silver is extracted as cationic complex.
 (c) Nickel is purified by zone refining.
 (d) Zr and Ti are purified by van Arkel method.

23. The compound(s) with two lone pairs of electrons on the central atom is(are)

- (a) BrF_5 (b) ClF_3 (c) XeF_4 (d) SF_4

Integer / Numerical Value Type

24. The number of geometric isomers possible for the complex $[\text{CoL}_2\text{Cl}_2]^-$ ($\text{L} = \text{H}_2\text{NCH}_2\text{CH}_2\text{O}^-$) is _____.

25. 29.2% (w/w) HCl stock solution has a density of 1.25 g mL^{-1} . The molecular weight of HCl is 36.5 g mol^{-1} . The volume (mL) of stock solution required to prepare a 200 mL solution of 0.4 M HCl is _____.



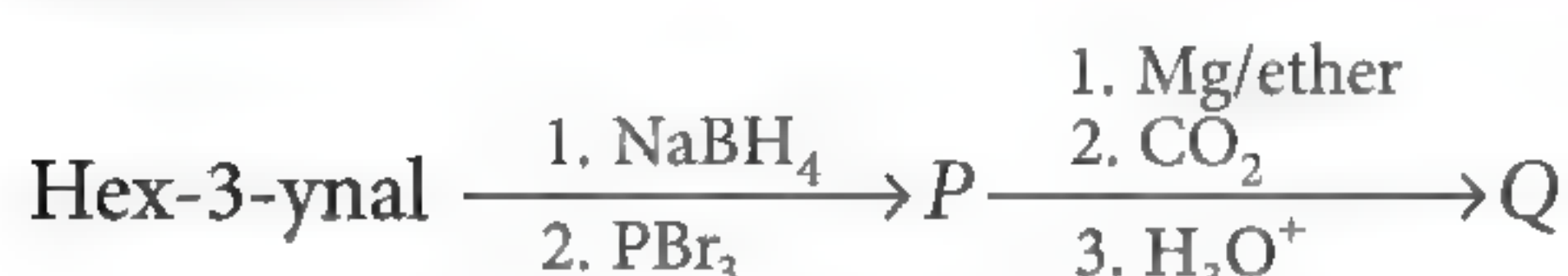
26. An alkyl halide $R-X$ gives nucleophilic substitution reaction with aqueous NaOH. The overall reaction rate in 0.01 M NaOH solution is given by the equation.

$$r = 2 \times 10^{-5} [R-X][^-OH] + 3 \times 10^{-7} [R-X]$$

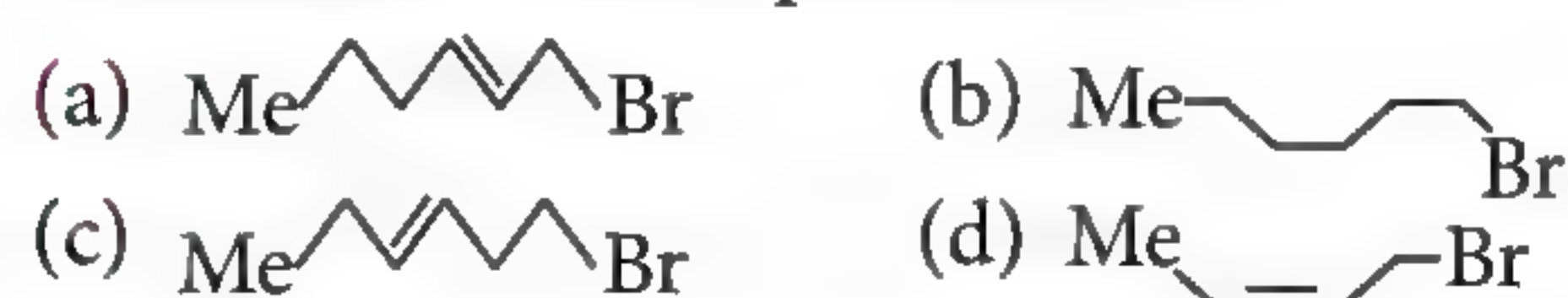
If the percentage yield of S_N2 reaction is represented as $(n \times 10)$ the value of n is _____.

Comprehension Type

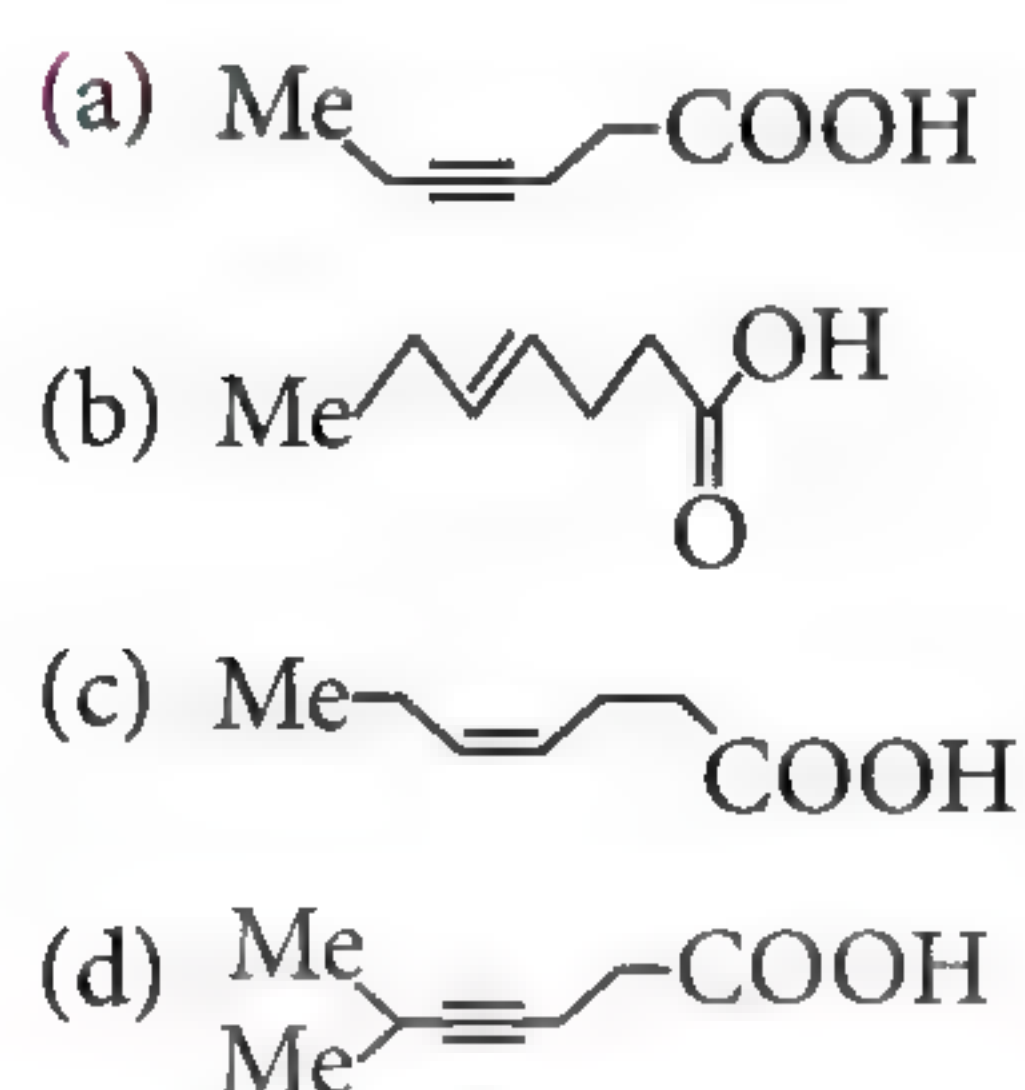
In the following reaction sequence, products P and Q are formed.



27. The structure of the product P is



28. The structure of compound Q is



Matching List

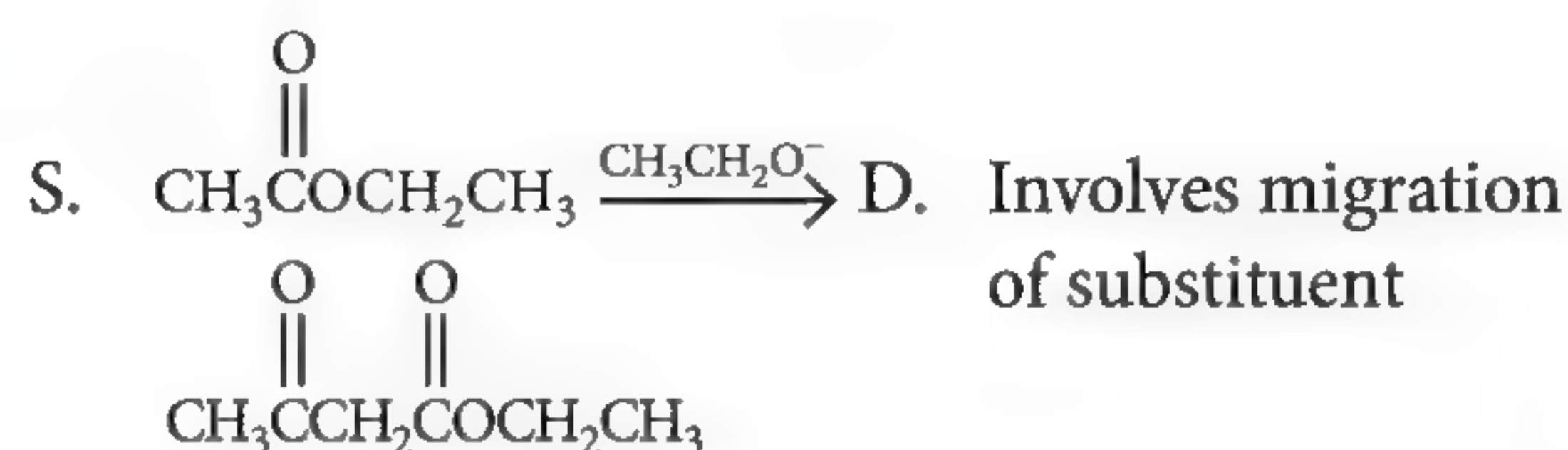
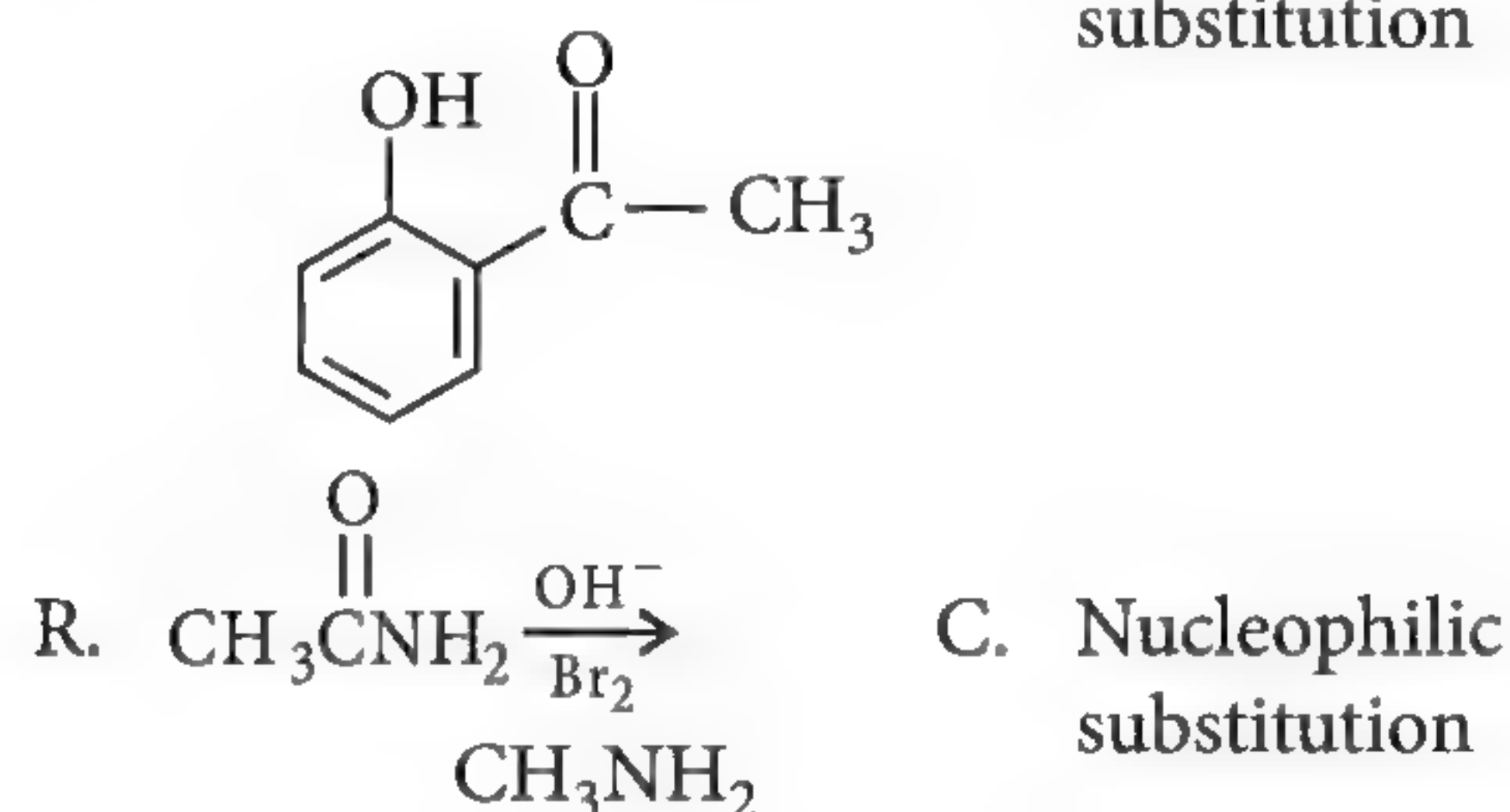
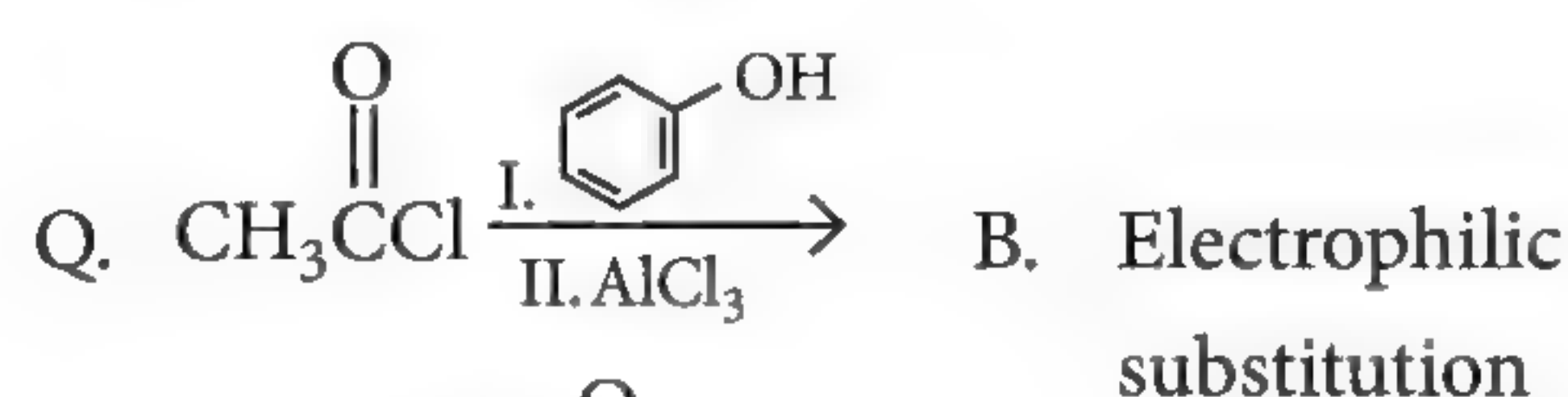
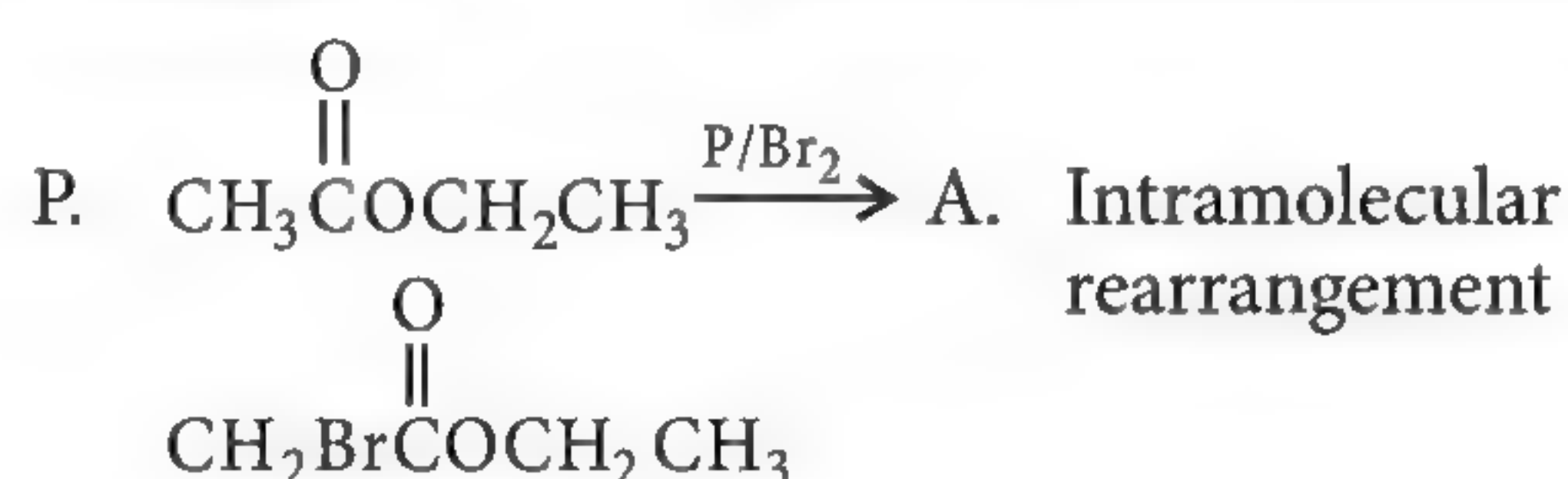
29. Match the enzymes given in List I with the reactions they catalyse given in List II and select the correct answer using the code given below the lists:

List I	List II
P. Invertase	1. Decomposition of urea into NH_3 and CO_2
Q. Maltase	2. Hydrolysis of maltose into glucose
R. Pepsin	3. Hydrolysis of cane sugar
S. Urease	4. Hydrolysis of proteins into peptides

	P	Q	R	S
(a)	1	2	3	4
(b)	3	2	4	1
(c)	2	4	3	1
(d)	1	2	4	3

30. Match the List I with List II and select the correct answer using the code given below the lists :

List I (Reaction)	List II (Nature of reaction involved)
----------------------	--



	A	B	C	D
(a)	P, Q	P, Q, R	P, Q	R, S
(b)	Q, R	R, S	R, S	Q
(c)	Q	P, Q, R, S	P, Q, S	R
(d)	P	P, Q, R, S	P, Q, R	S



Keys are published in this issue. Search now! ☺

SELF CHECK

No. of questions attempted

No. of questions correct

Marks scored in percentage

Check your score! If your score is

> 90%	EXCELLENT WORK !	You are well prepared to take the challenge of final exam.
90-75%	GOOD WORK !	You can score good in the final exam.
74-60%	SATISFACTORY !	You need to score more next time.
< 60%	NOT SATISFACTORY!	Revise thoroughly and strengthen your concepts.



CBSE

warm-up!

Term-II
Exam on
7th May

CLASS-XII

Practice Paper 2022

Time Allowed : 2 hours
Maximum Marks : 35

General Instructions : Read the following instructions carefully.

- There are 12 questions in this question paper with internal choice.
- SECTION A - Q. No. 1 to 3 are very short answer questions carrying 2 marks each.
- SECTION B - Q. No. 4 to 11 are short answer questions carrying 3 marks each.
- SECTION C - Q. No. 12 is case based question carrying 5 marks.
- All questions are compulsory.
- Use of log tables and calculators is not allowed.

SECTION - A

- Write the expression for the rate of reaction given below.

$$5\text{Br}^-_{(aq)} + \text{BrO}^-_{3(aq)} + 6\text{H}^+_{(aq)} \longrightarrow 3\text{Br}_{2(aq)} + 3\text{H}_2\text{O}_{(l)}$$
- Illustrate the following name reactions giving a chemical equation in each case :
 (a) Clemmensen reaction
 (b) Cannizzaro reaction
- Calculate $\Lambda^\infty_{\text{HOAc}}$ (in $\text{S cm}^2 \text{mol}^{-1}$) using appropriate molar conductances of the electrolytes listed in the given table.

Electrolyte	KCl	HCl	NaOAc	NaCl
Λ^∞ ($\text{S cm}^2 \text{mol}^{-1}$)	149.9	426.2	91.0	126.5

SECTION - B

- Explain and give reason :
 $[\text{CoF}_6]^{3-}$ is outer orbital but $[\text{Co}(\text{NH}_3)_6]^{3+}$ is inner orbital complex.

- Following data are obtained for the reaction :



t/s	0	300	600
$[\text{N}_2\text{O}_5]/\text{mol L}^{-1}$	1.6×10^{-2}	0.8×10^{-2}	0.4×10^{-2}

- Show that it follows first order reaction.
- Calculate the half-life.
(Given : $\log 2 = 0.3010$, $\log 4 = 0.6021$)

OR

- A reaction is first order in A and second order in B.
 (a) Write differential rate equation.
 (b) How is rate affected when concentration of B is tripled?
 (c) How is rate affected when concentration of both A and B is doubled?
 - What is molecularity of a reaction?
- A compound X ($\text{C}_7\text{H}_7\text{Br}$) reacts with KCN to give Y ($\text{C}_8\text{H}_7\text{N}$). Reduction of Y with LiAlH_4 yields Z

(C₈H₁₁N). Z gives carbylamine reaction, reacts with Hinsberg's reagent in the presence of aq. KOH to give a clear solution. With NaNO₂ and HCl at 0°C (Z) gives a neutral compound which gives red colour with ammonium ceric nitrate. What are X, Y and Z?

7. Write the name, the structure and the magnetic behaviour of each one of the following complexes :

- (i) [Pt(NH₃)₂Cl(NO₂)]
 (ii) [Co(NH₃)₄Cl₂]Cl
 (iii) Ni(CO)₄
 (At. nos. Co = 27, Ni = 28, Pt = 78)

8. Define the following :

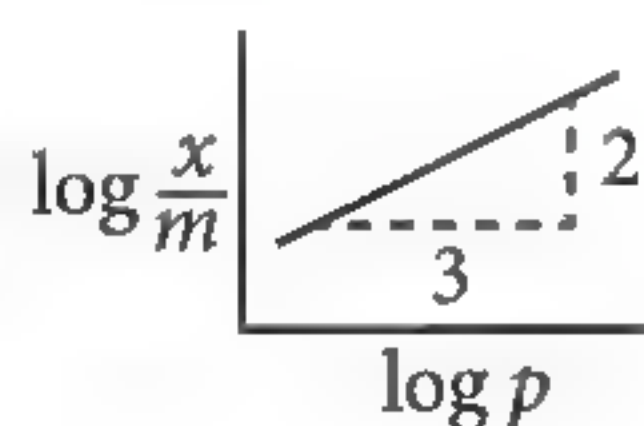
- (a) Micelles
 (b) Aerosol
 (c) Coagulation of colloids

OR

- (a) Adsorption of a gas follows Freundlich adsorption isotherm. x is the mass of the gas adsorbed on mass m of the adsorbent.

The plot of $\log \frac{x}{m}$ versus $\log p$ is shown in the given graph.

Determine the proportionality of $\frac{x}{m}$.



- (b) Define :
 (i) Peptization (ii) Kraft temperature

9. (a) Transition metals have very high melting and boiling points. Why?
 (b) In d -block elements, ionic radii of ions of the same charge decreases progressively with increasing atomic number in a series. Why?
 (c) Transition metals and their compounds show catalytic activity. Why?

OR

Following are the transition metal ions of 3d series :
 Ti⁴⁺, V²⁺, Mn³⁺, Cr³⁺

(Atomic numbers : Ti = 22, V = 23, Mn = 25, Cr = 24)

Answer the following :

- (i) Which ion is most stable in aqueous solution and why?
 (ii) Which ion is strong oxidising agent and why?
 (iii) Which ion is colourless and why?

10. (i) Ammonolysis of alkyl halides is not a good method to prepare pure primary amines.

- (ii) Arrange the following compounds as directed :

- (a) In increasing order of solubility in water :
 (CH₃)₂NH, CH₃NH₂, C₆H₅NH₂
 (b) In increasing order of boiling point :
 (C₂H₅)₂NH, (C₂H₅)₃N, C₂H₅NH₂

OR

Write the structures of main products when aniline reacts with the following reagents :

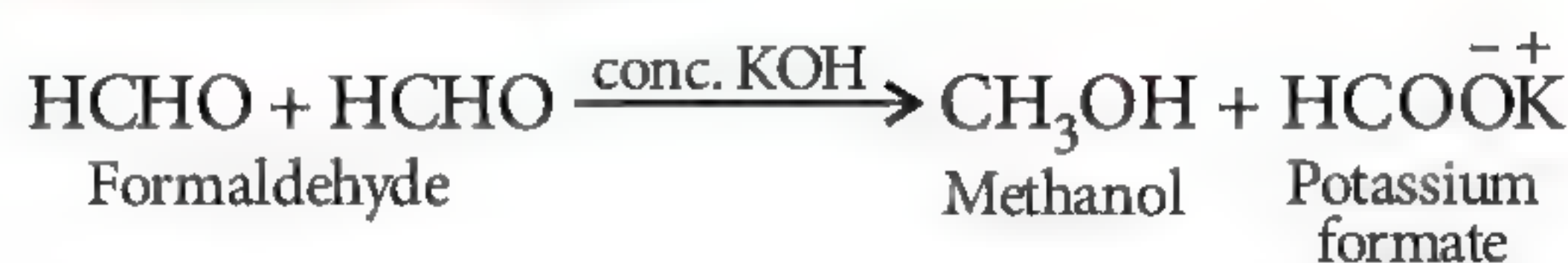
- (i) Br₂ water (ii) HCl
 (iii) (CH₃CO)₂O/pyridine

11. (a) The E° for the cell reaction,
 $\text{Cu}_{(s)} + 2\text{Ag}^+_{(aq)} \longrightarrow \text{Cu}^{2+}_{(aq)} + 2\text{Ag}_{(s)}$ is 0.46 V, what is its equilibrium constant?
 (b) At infinite dilution in the aqueous solution of BaCl₂, molar conductivity of Ba²⁺ and Cl⁻ ions are 127.32 S cm²/mol and 76.34 S cm²/mol, respectively. What is the molar conductivity for BaCl₂ at same dilution?

SECTION - C

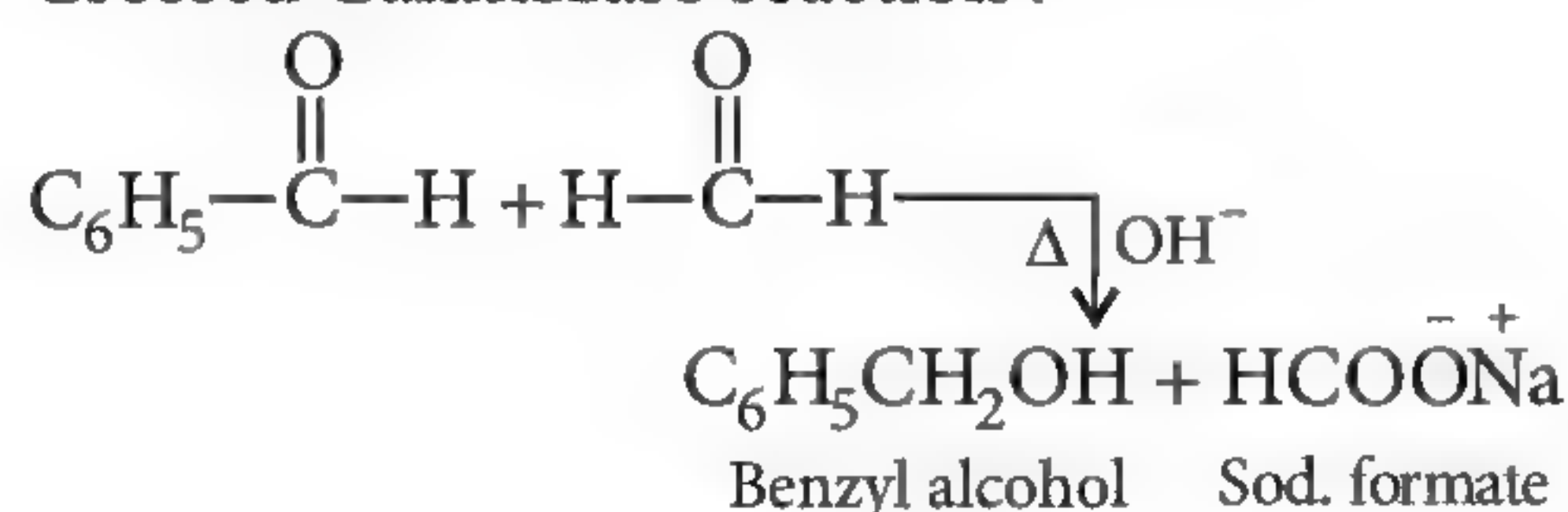
12. Read the passage given below and answer the questions that follow:

Cannizzaro reaction :



(aldehydes which do not have an α -hydrogen atom)

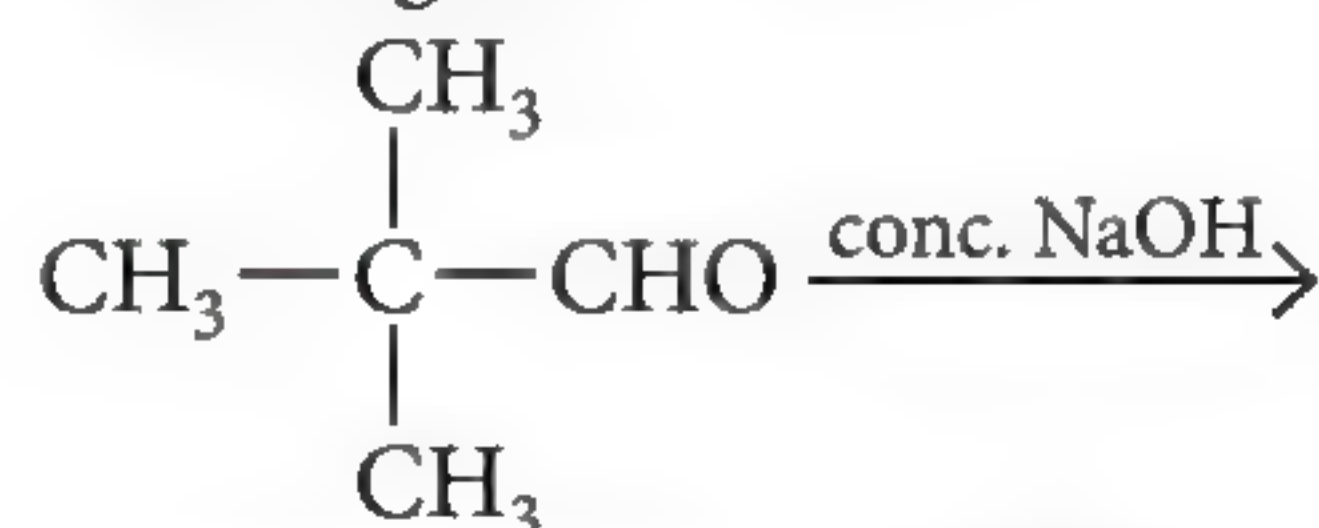
Crossed Cannizzaro reaction :



Intramolecular Cannizzaro reaction :

It is given by dialdehydes having no α -hydrogen atoms.

- (a) Write the structure of major product in the following reaction.



- (b) $\text{CH}_3\text{CHO} + \text{HCHO} \xrightarrow[\text{Heat}]{\text{dil. NaOH}} \text{A} \xrightarrow[\text{H}_3\text{O}^+]{\text{HCN}} \text{B}$

The structure of compound B is

- (c) Complete the following reaction :



- (d) Out of benzaldehyde and acetaldehyde one gives Cannizzaro reaction and the other undergoes aldol condensation. Identify and give their respective reactions.

OR

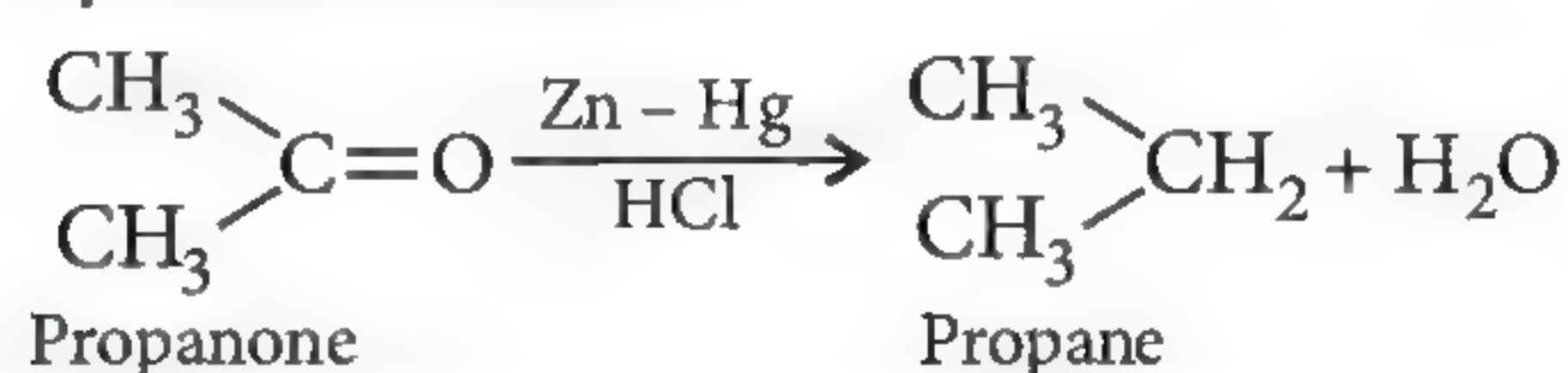
What are the Cannizzaro product of trichloro-acetaldehyde?

SOLUTIONS

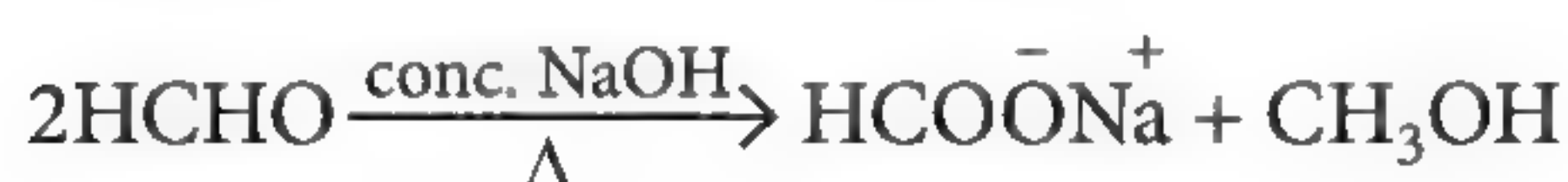
$$1. \text{ Rate} = -\frac{1}{5} \frac{\Delta[\text{Br}^-]}{\Delta t} = -\frac{\Delta[\text{BrO}_3^-]}{\Delta t} = -\frac{1}{6} \frac{\Delta[\text{H}^+]}{\Delta t}$$

$$= \frac{1}{3} \frac{\Delta[\text{Br}_2]}{\Delta t} = \frac{1}{3} \frac{\Delta[\text{H}_2\text{O}]}{\Delta t}$$

2. (a) Clemmensen reduction : The carbonyl group of aldehydes and ketones is reduced to $>\text{CH}_2$ group on treatment with zinc amalgam and concentrated hydrochloric acid.



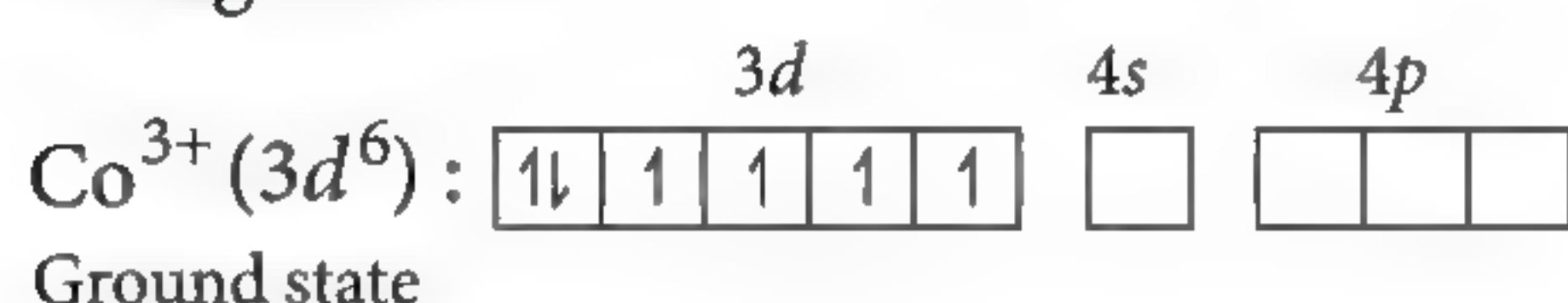
(b) Cannizzaro reaction : Aldehydes which do not contain α -H atom undergo disproportionation when heated with concentrated alkali.



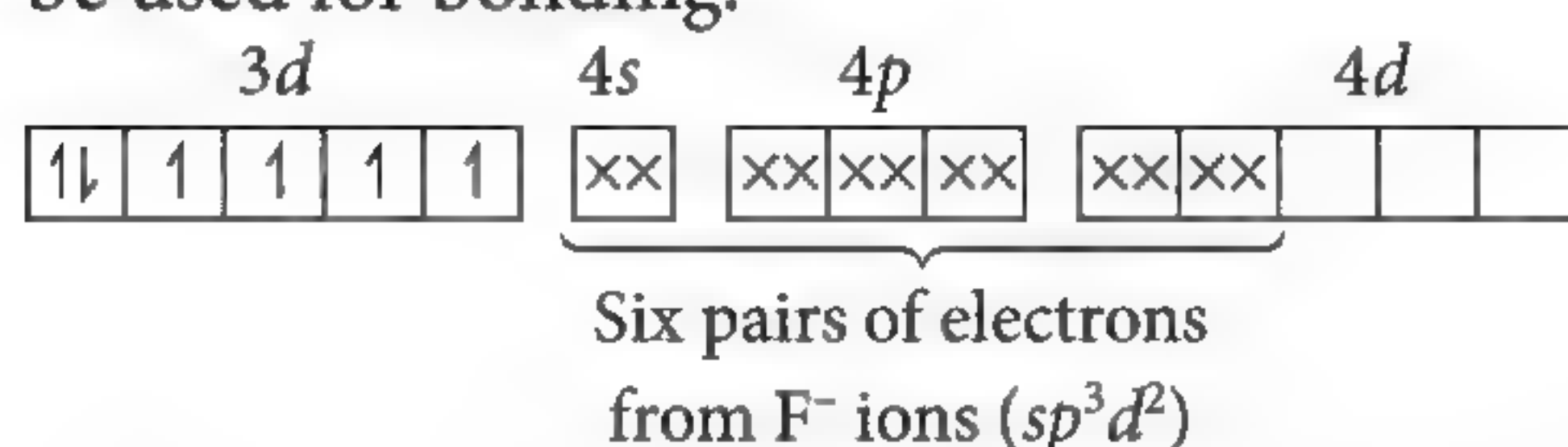
$$3. \Lambda_{\text{HOAc}}^\infty = \Lambda_{\text{NaOAc}}^\infty + \Lambda_{\text{HCl}}^\infty - \Lambda_{\text{NaCl}}^\infty$$

$$= (91.0 + 426.2 - 126.5) \text{ S cm}^2 \text{ mol}^{-1} = 390.7 \text{ S cm}^2 \text{ mol}^{-1}$$

4. In $[\text{CoF}_6]^{3-}$, Co is in +3 state and has $3d^6$ configuration.

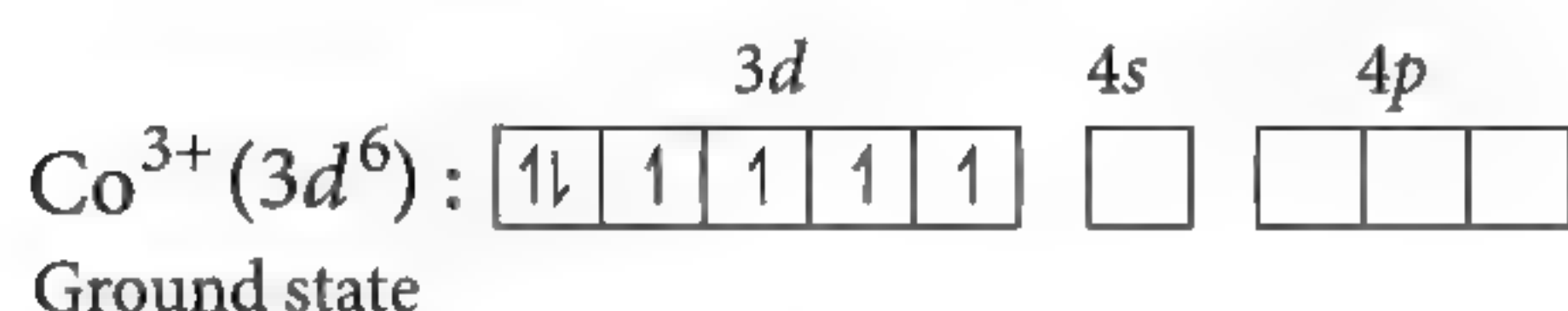


Since F^- is a weak field ligand. So, outer d -orbitals will be used for bonding.

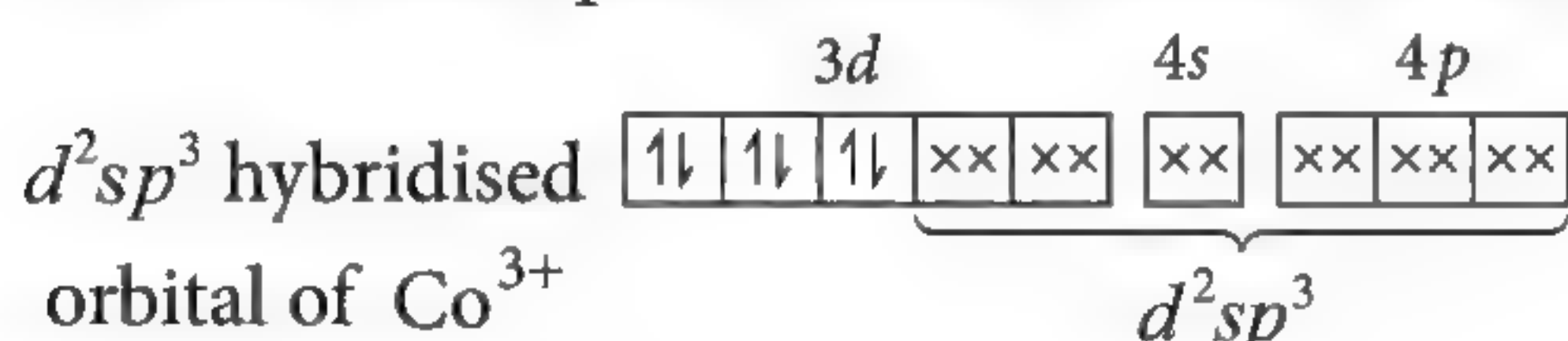


Since, outer d -orbitals are used for hybridisation. Therefore, it is an outer orbital complex.

In $[\text{Co}(\text{NH}_3)_6]^{3+}$, Co is in +3 state.



Since NH_3 is a strong field ligand, pairing of electrons in $3d$ -orbital takes place to make two $3d$ -orbitals vacant.



Since it uses inner d -orbitals for its hybridisation therefore, it is an inner orbital complex.

5. (a) The formula of rate constant for first order reaction is

$$k = \frac{2.303}{t} \log \frac{[A]_0}{[A]_t}$$

$$k_1 = \frac{2.303}{300 \text{ s}} \log \frac{(1.6 \times 10^{-2}) \text{ mol L}^{-1}}{(0.8 \times 10^{-2}) \text{ mol L}^{-1}} = 2.3 \times 10^{-3} \text{ s}^{-1}$$

$$\text{Similarly, } k_2 = \frac{2.303}{600 \text{ s}} \log \frac{(1.6 \times 10^{-2}) \text{ mol L}^{-1}}{(0.4 \times 10^{-2}) \text{ mol L}^{-1}}$$

$$= 2.3 \times 10^{-3} \text{ s}^{-1}$$

Unit and magnitude of rate constant shows the given reaction is of first order.

(b) The formula for half-life for first order reaction is

$$t_{1/2} = \frac{0.693}{k} = \frac{0.693}{2.3 \times 10^{-3} \text{ s}^{-1}} = 301.30$$

For the SCIENTIST in YOU

Unusual hydrogen bonds found in proteins help them bind their targets !!

Chemists in India have published what they say is the first evidence for hydrogen bonds with tetravalent carbon atoms in proteins.

The discovery is surprising because the origin and nature of these hydrogen bonds are very different to conventional ones. On one side such interactions usually have a hydrogen bond donor – namely a hydrogen atom, attached to an electronegative atom like oxygen. Conventionally, hydrogen bond acceptors are also electronegative atoms, with electrons as lone pairs or in p-orbitals from multiple bonds. That's not true for the carbon atoms that are the hydrogen bond acceptors here. The hydrogen bond donors are also often not attached to electronegative atoms.

On the electronegativity scale, carbon has a value of 2.55, very similar to hydrogen at 2.2. People probably therefore thought that it couldn't gather enough electrons to be a hydrogen bond acceptor. But in recent years, scientists have shown that carbon atoms in methane, which has neither lone pairs nor p-electrons, can be hydrogen bond acceptors. Yet no-one had looked for similar interactions in protein crystal structures.

The researchers found 1051 interactions in 918 different crystals. 843 of the crystals had interactions between tetravalent carbon hydrogen bond acceptors and hydrogen bond donors where hydrogen was attached to carbon, rather than a more electronegative atom.

OR

(i) (a) Differential rate equation of reaction is

$$\frac{dx}{dt} = k[A]^1[B]^2 = k[A][B]^2$$

(b) When conc. of B is tripled, it means conc. of B becomes [3B]

$$\therefore \text{New rate of reaction, } \frac{dx'}{dt} = k[A][3B]^2 = 9k[A][B]^2$$

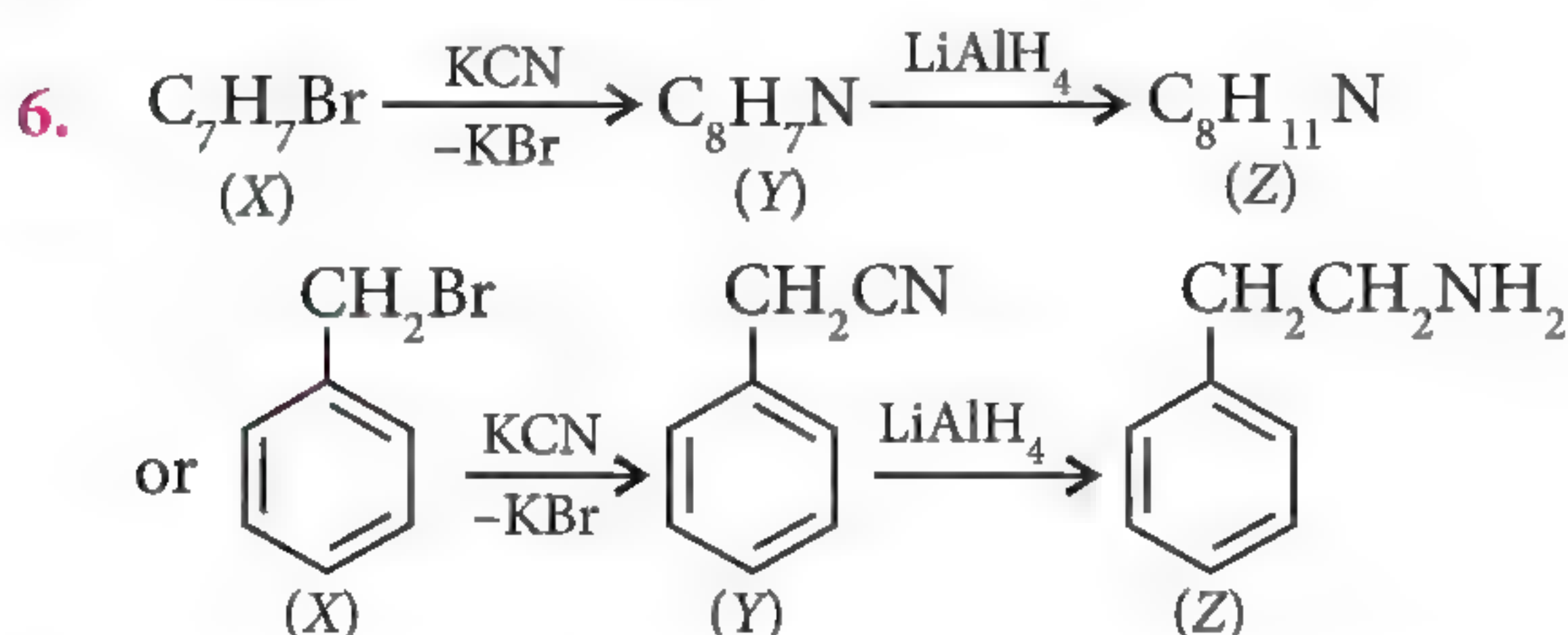
i.e., the rate of reaction will become 9 times.

(c) When conc. of A is doubled and that of B is also doubled, then conc. of A becomes [2A] and that of B becomes [2B].

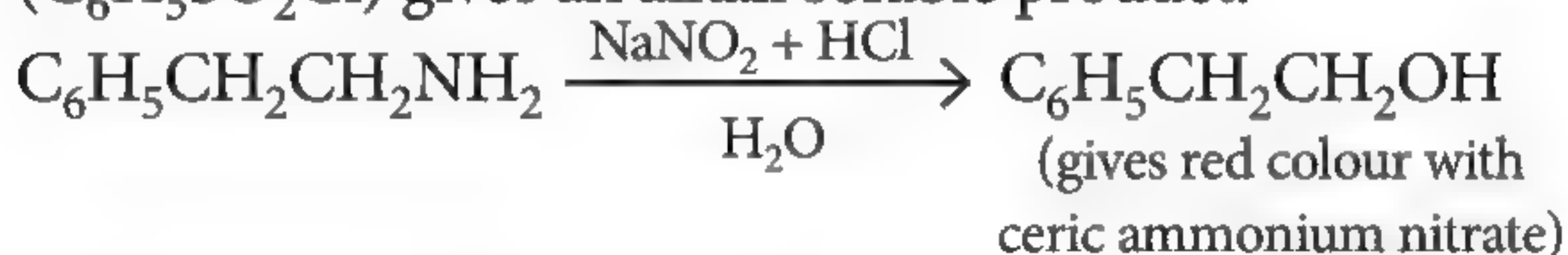
$$\therefore \text{Now rate of reaction, } \frac{dx'}{dt} = k[2A][2B]^2 = 8k[A][B]^2$$

i.e., the rate of reaction will become 8 times.

(ii) Molecularity of a reaction is the number of reacting species in an elementary reaction which collide simultaneously to bring about the chemical reaction. It is a theoretical concept.



$\text{C}_6\text{H}_5\text{CH}_2\text{CH}_2\text{NH}_2$ (Z) being a 1° amine gives carbylamine test and on treatment with Hinsberg's reagent ($\text{C}_6\text{H}_5\text{SO}_2\text{Cl}$) gives an alkali soluble product.



7. (i) $[\text{Pt}(\text{NH}_3)_2\text{Cl}(\text{NO}_2)]$:

Diamminechloridonitrito-N-platinum(II)

It is square planar and diamagnetic.

(ii) $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$:

Tetraamminedichloridocobalt(III) chloride

It is octahedral and diamagnetic.

(iii) $\text{Ni}(\text{CO})_4$: Tetracarbonylnickel(0)

It is tetrahedral and diamagnetic.

8. (a) Aggregated particles of associated colloids at high concentration are called micelles, e.g., soaps.

(b) A colloid of a solid or liquid dispersed in a gas is called aerosol, e.g., fog, smokes, dust, etc.

(c) The process of aggregation of the colloidal particles into large sized particle which ultimately settle down under the force of gravity as a precipitate is called coagulation.

OR

(a) According to Freundlich adsorption isotherm, $\log x/m = \log k + 1/n \log p$.

\therefore For a plot between $\log x/m$ and $\log p$ slope is given by $1/n$.

$$\text{Thus, from the plot } \frac{1}{n} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{2}{3} \text{ and}$$

$$x/m \propto p^{1/n} \propto p^{2/3}$$

(b) (i) Peptization : It is the process of conversion of freshly prepared precipitate into colloid on adding a suitable electrolyte.

(ii) Kraft temperature : it is defined as the temperature above which the micelle formation takes place.

9. (a) The high melting and boiling points of transition metals are attributed to the involvement of greater number of electrons from $(n-1)$ d -orbital in addition to the ns electrons in the interatomic metallic bonding ($d-d$ overlap).

(b) As the atomic number increases the new electron enters the d -orbital and an increase in atomic size is expected, but due to poor shielding effect of d -orbitals the electrostatic attraction between nucleus and outermost orbital increases and hence, the ionic radii decreases.

(c) The transition metals and their compounds, are known for their catalytic activity. This activity is ascribed to their ability to adopt multiple oxidation states, ability to adsorb the reactant(s) and ability to form complexes. Vanadium(V) oxide (in Contact Process), finely divided iron (in Haber's Process), and nickel (in catalytic hydrogenation) are some of the examples. Catalysis involves the formation of bonds between reactant molecules and atoms at the surface of the catalyst.

OR

(i) Ti^{4+} has highest oxidation state among the given ions. Ti^{4+} has stable inert gas configuration and hence, most stable in aqueous solution.

On the other hand, V^{2+} , Mn^{3+} , Cr^{3+} have unstable electronic configuration and hence, are less stable.

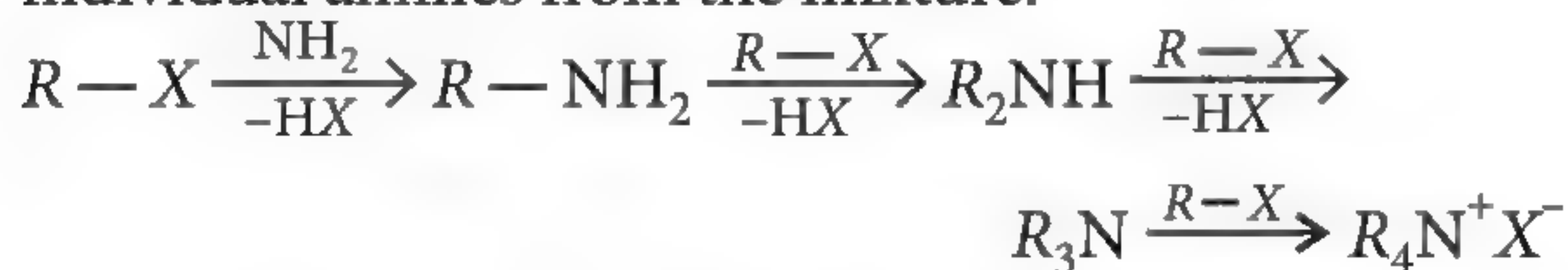
(ii) Due to presence of highest oxidation state of Ti, it acts as the strongest oxidising agent among the given ions.

(iii) Due to absence of unpaired electron in Ti^{4+} , it is a colourless ion.

$$\text{E.C. of } \text{Ti}^{4+} = [\text{Ar}]3d^04s^0$$

10. (i) The ammonolysis of alkyl halides with ammonia is a nucleophilic substitution reaction in

which ammonia acts as a nucleophile by donating the electron pair on nitrogen atom to form primary amine as the initial product. Now, the primary amine can act as a nucleophile and combine with alkyl halide (if available) to give secondary amine and the reaction continues in the same way to form tertiary amine and finally quaternary ammonium salt. Thus, a mixture of products is formed and it is not possible to separate individual amines from the mixture.



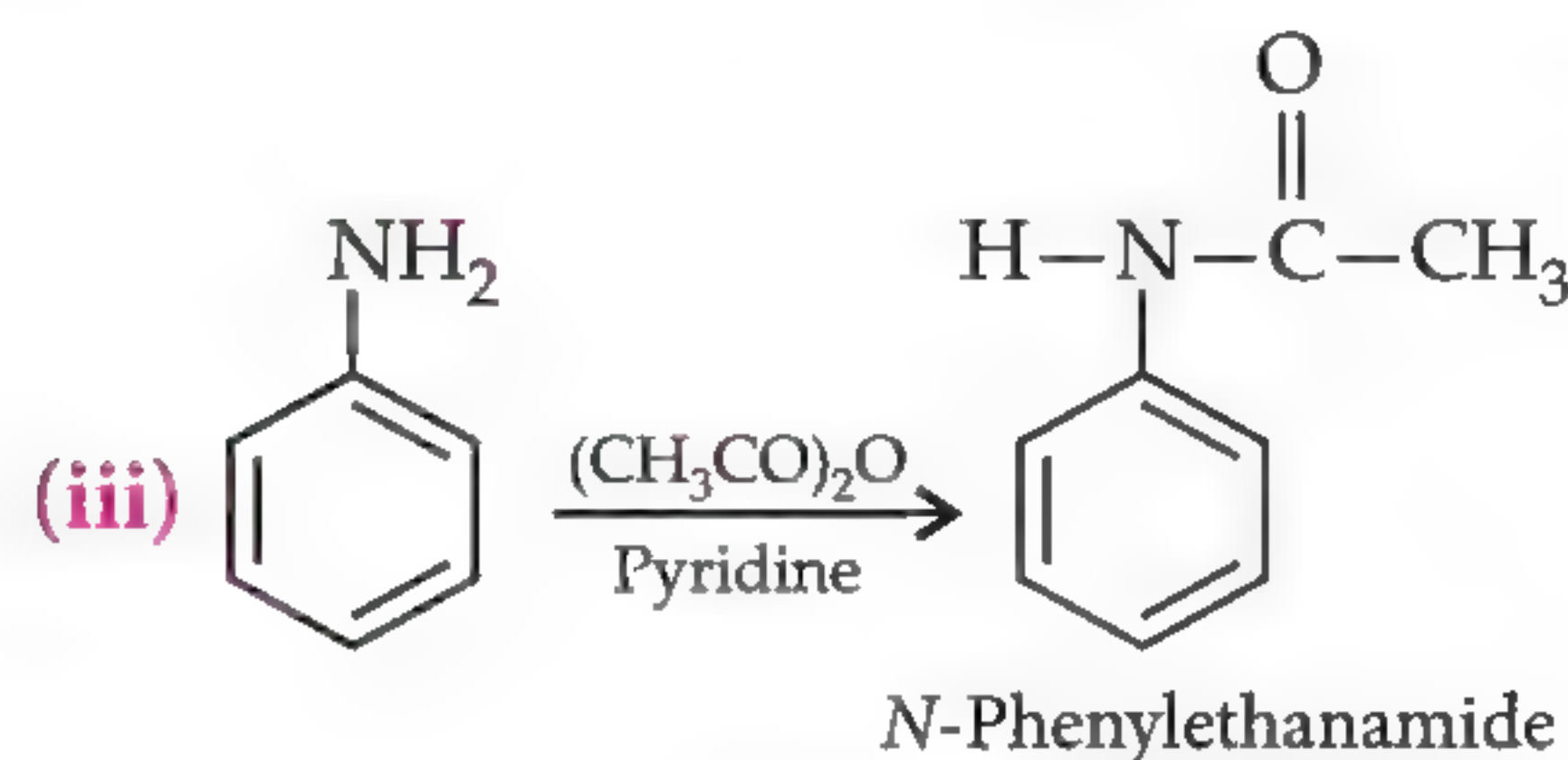
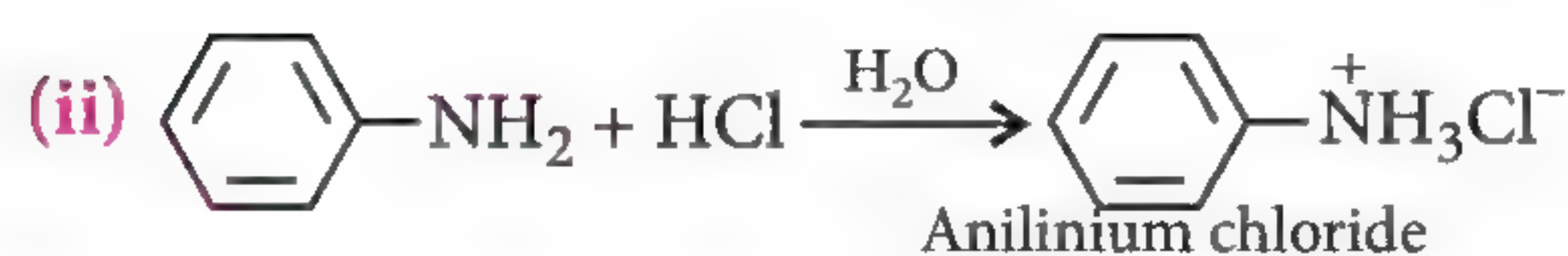
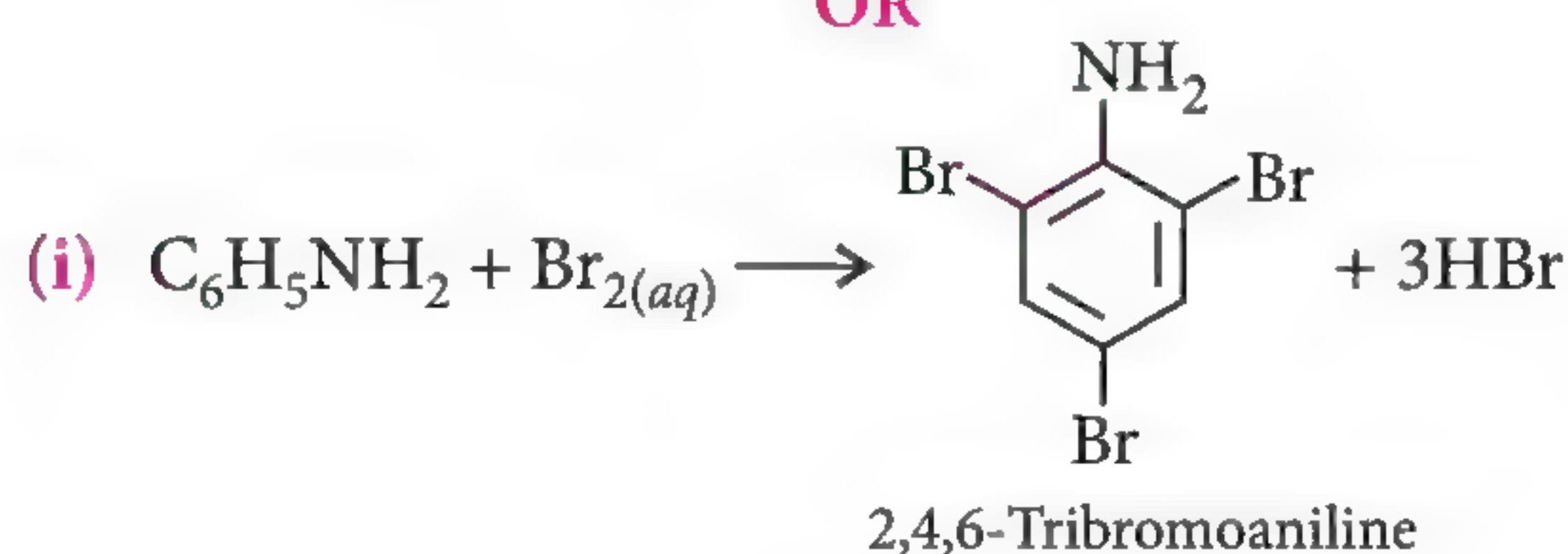
(ii) (a) $C_6H_5NH_2 < (CH_3)_2NH < CH_3NH_2$

1° amines are more soluble in water than 2° amines. Aniline is least soluble due to large hydrophobic benzene ring.

(b) 1° amines have two, 2° amines have one while 3° amines have no hydrogen linked to nitrogen. The degree of association due to hydrogen bonding and hence the boiling point increase as



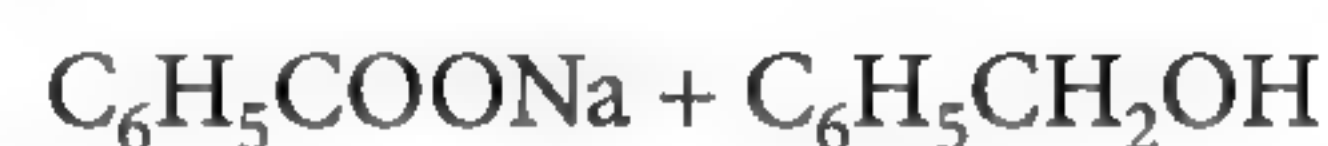
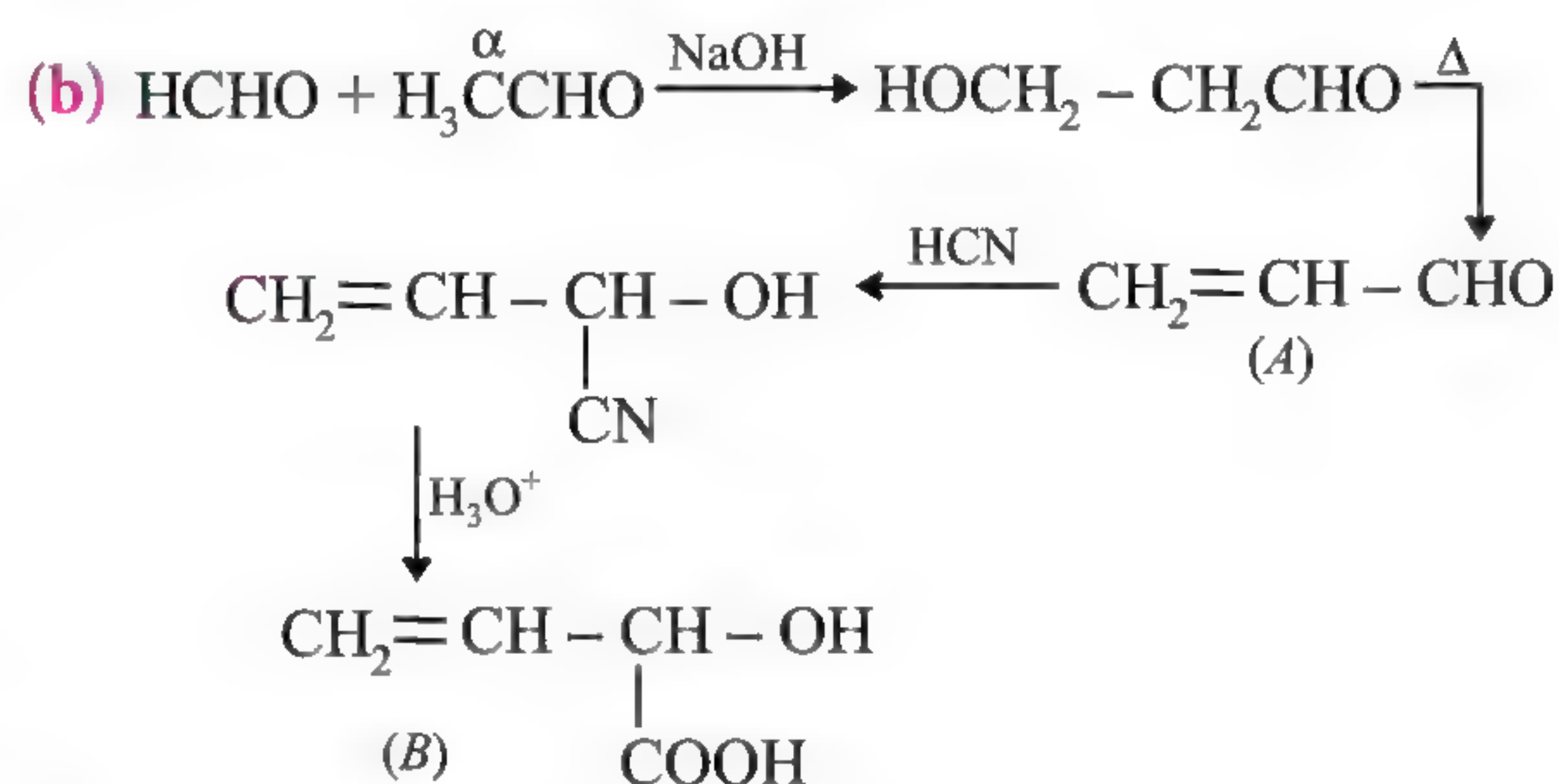
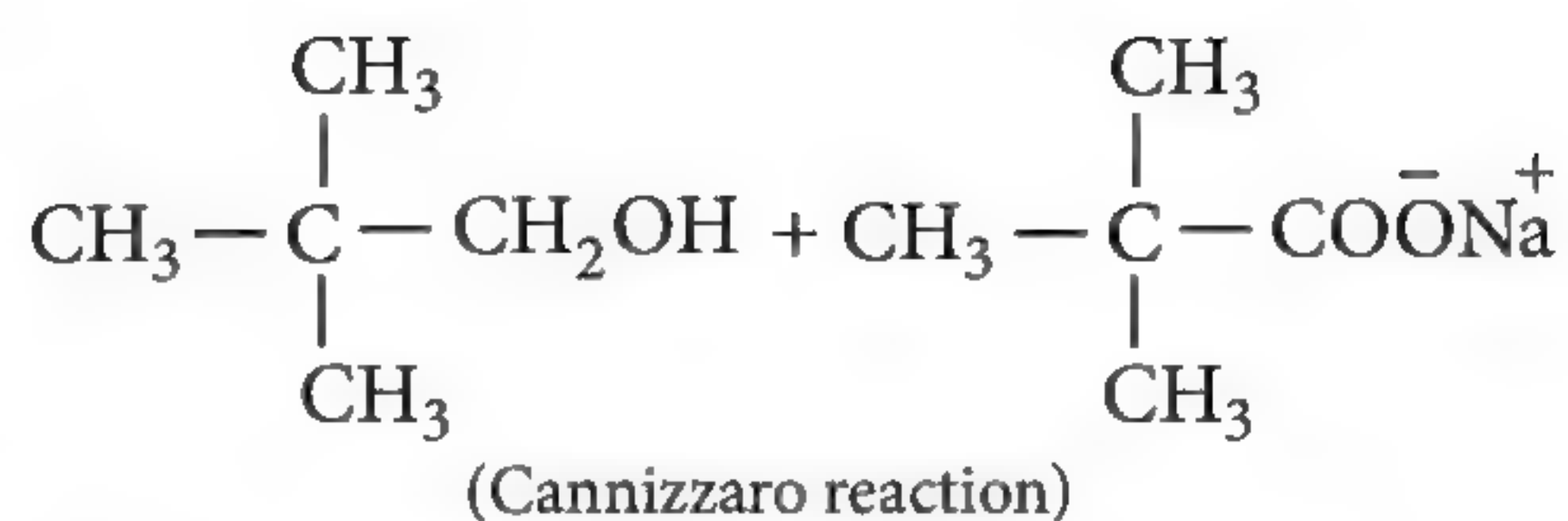
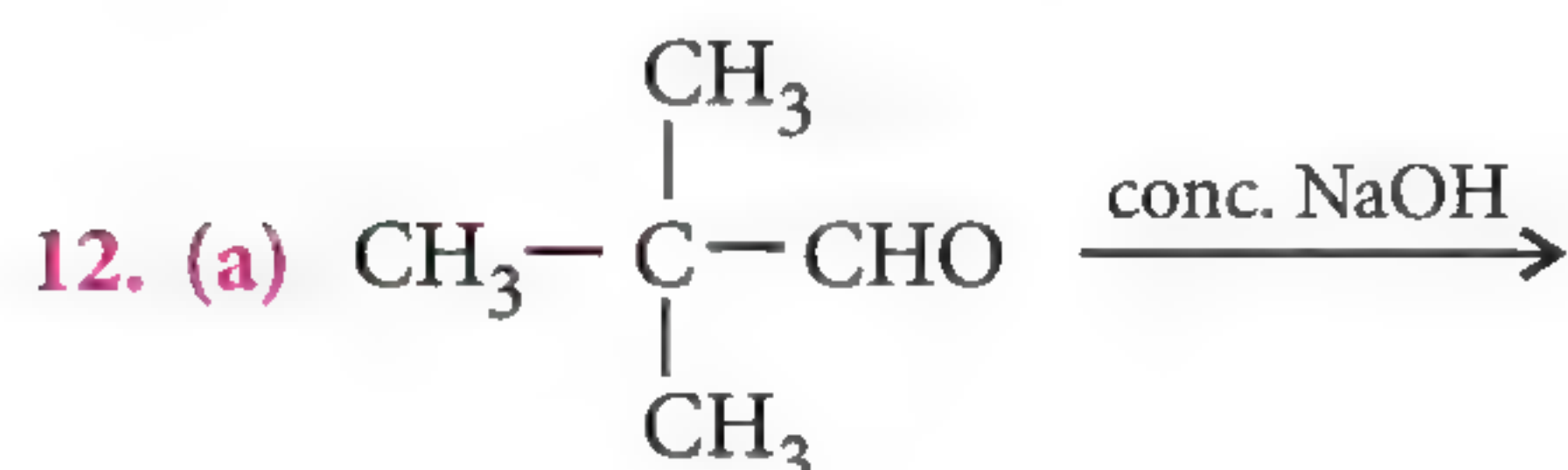
OR



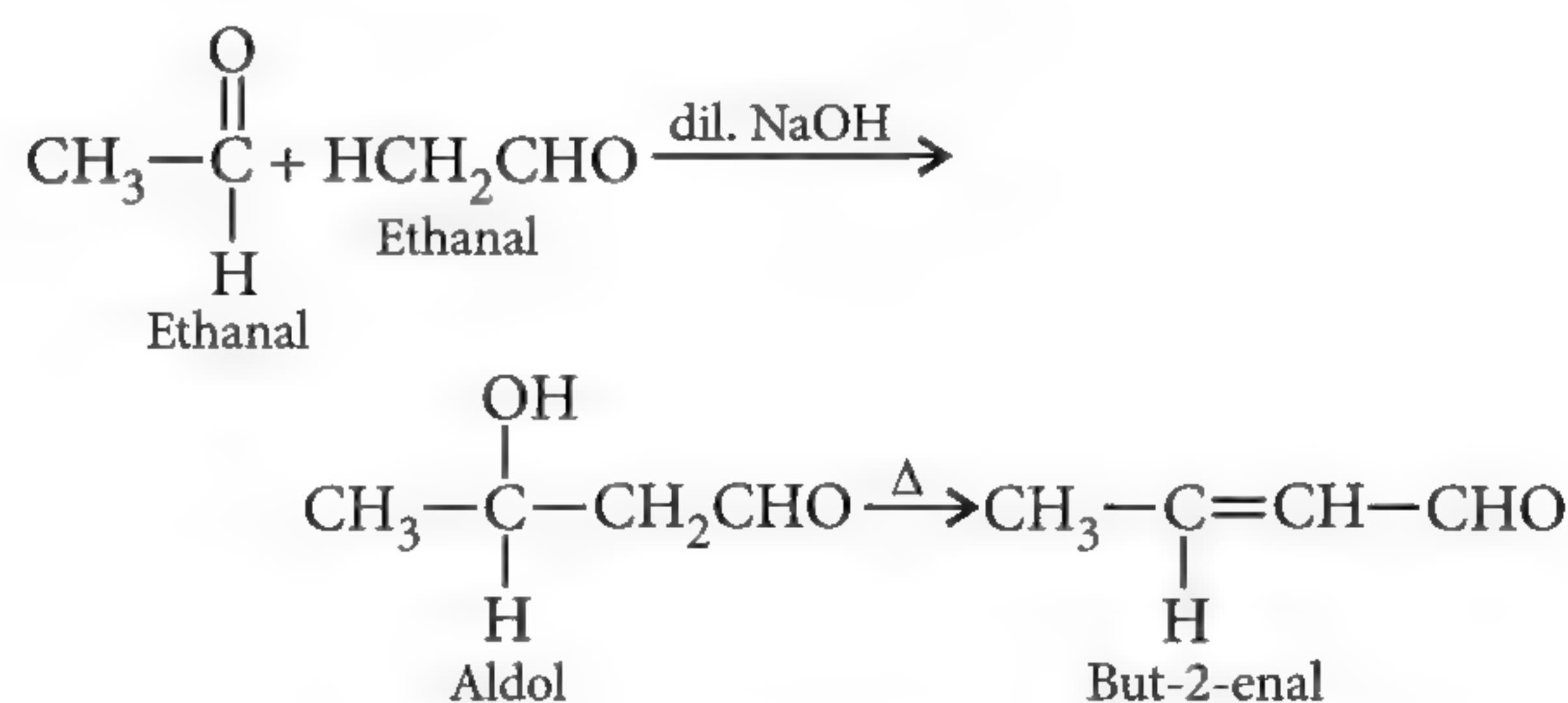
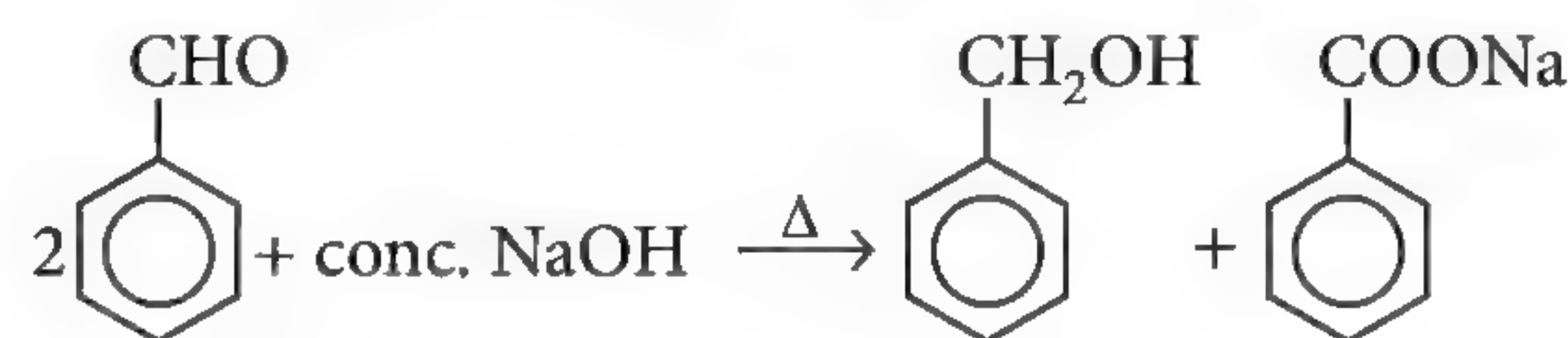
11. (a) $E^\circ_{\text{cell}} = \frac{0.059}{2} \log K_c$

or $\log K_c = \frac{0.46 \times 2}{0.059} = 15.6 \therefore K_c = 4 \times 10^{15}$

(b) $\Lambda_m^\circ \text{BaCl}_2 = \lambda_{\text{Ba}^{2+}}^\circ + 2\lambda_{\text{Cl}^-}^\circ$
 $= 127.32 + 2(76.34) = 280 \text{ S cm}^2 \text{ mol}^{-1}$

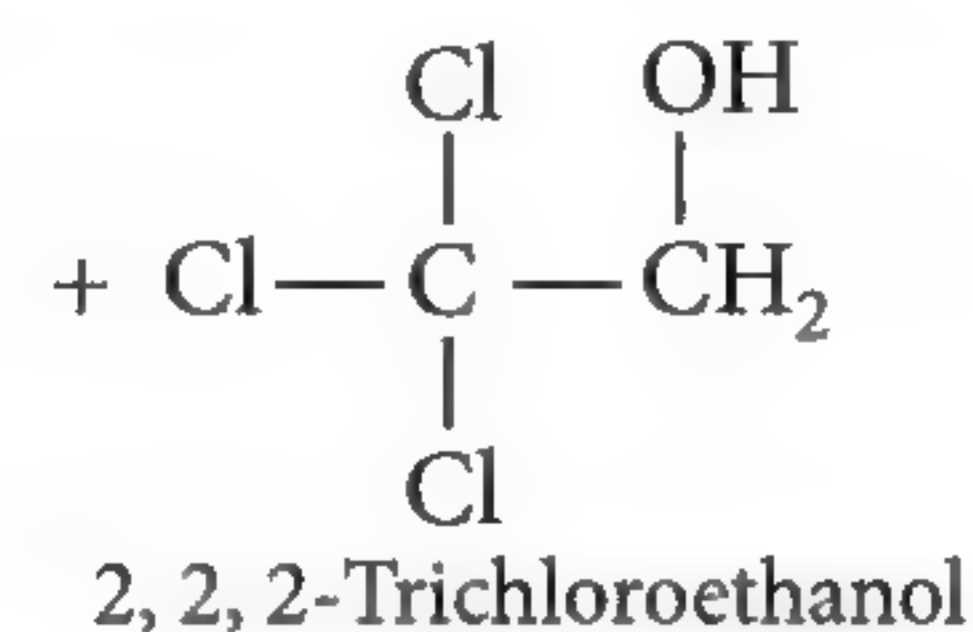
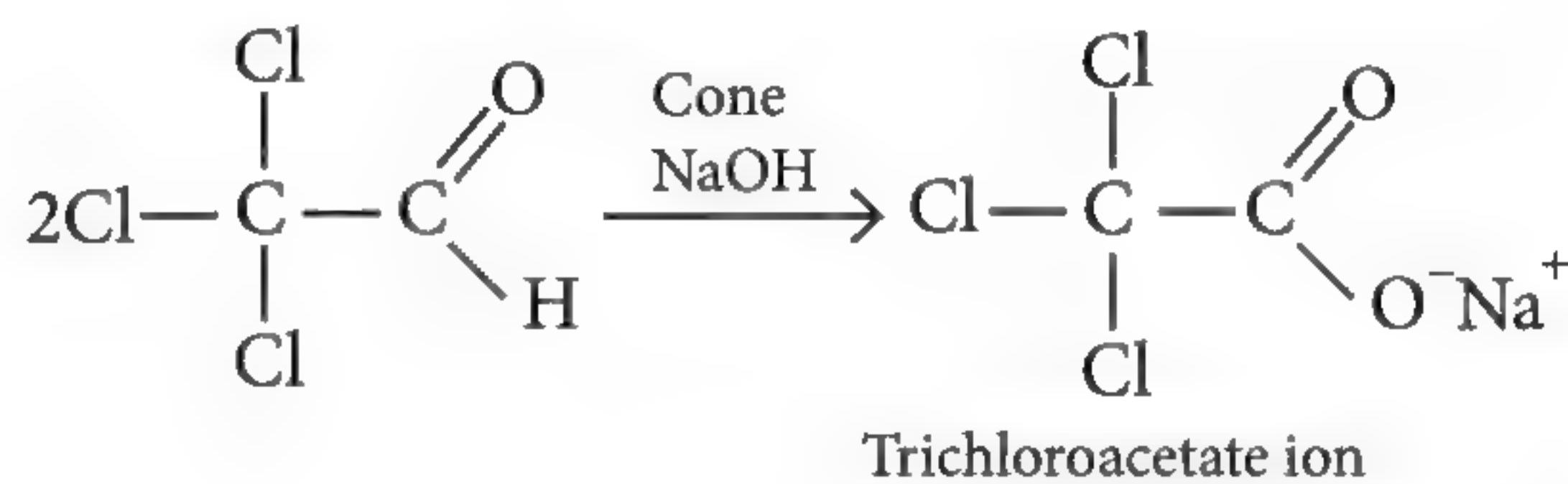


(d) Benzaldehyde undergoes Cannizzaro reaction while acetaldehyde undergoes Aldol condensation.



OR

The Cannizzaro product of given reaction yields.





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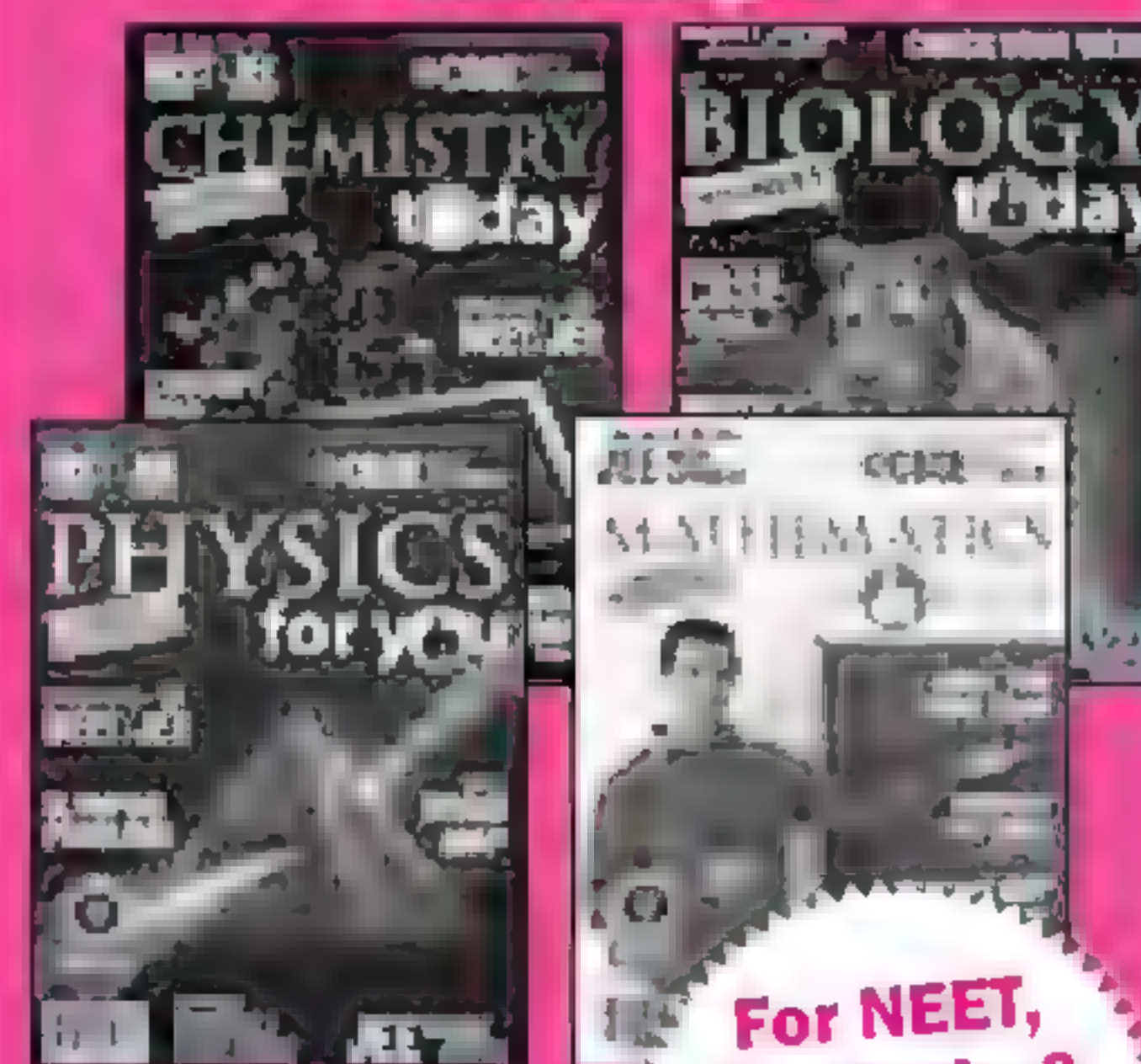
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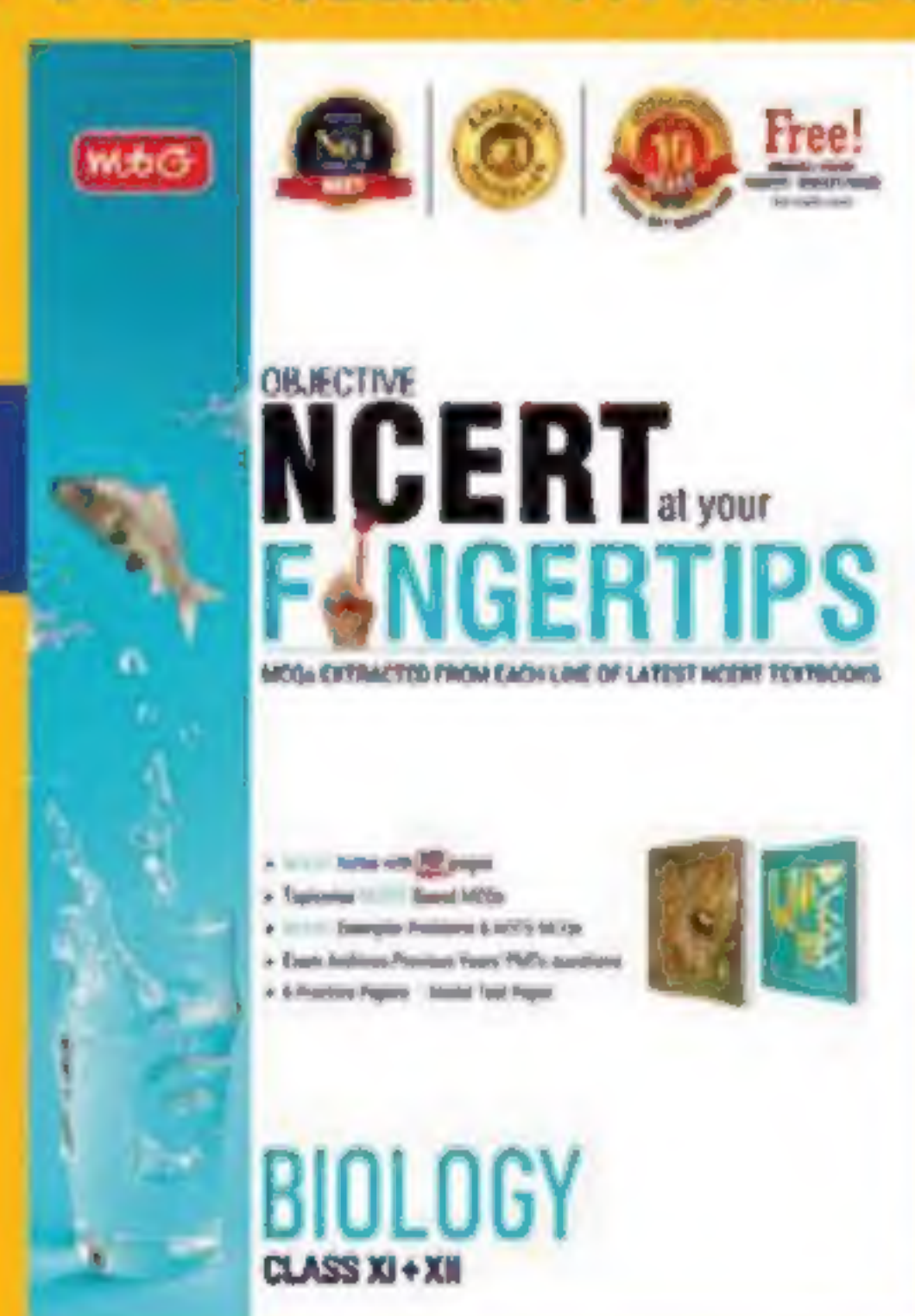
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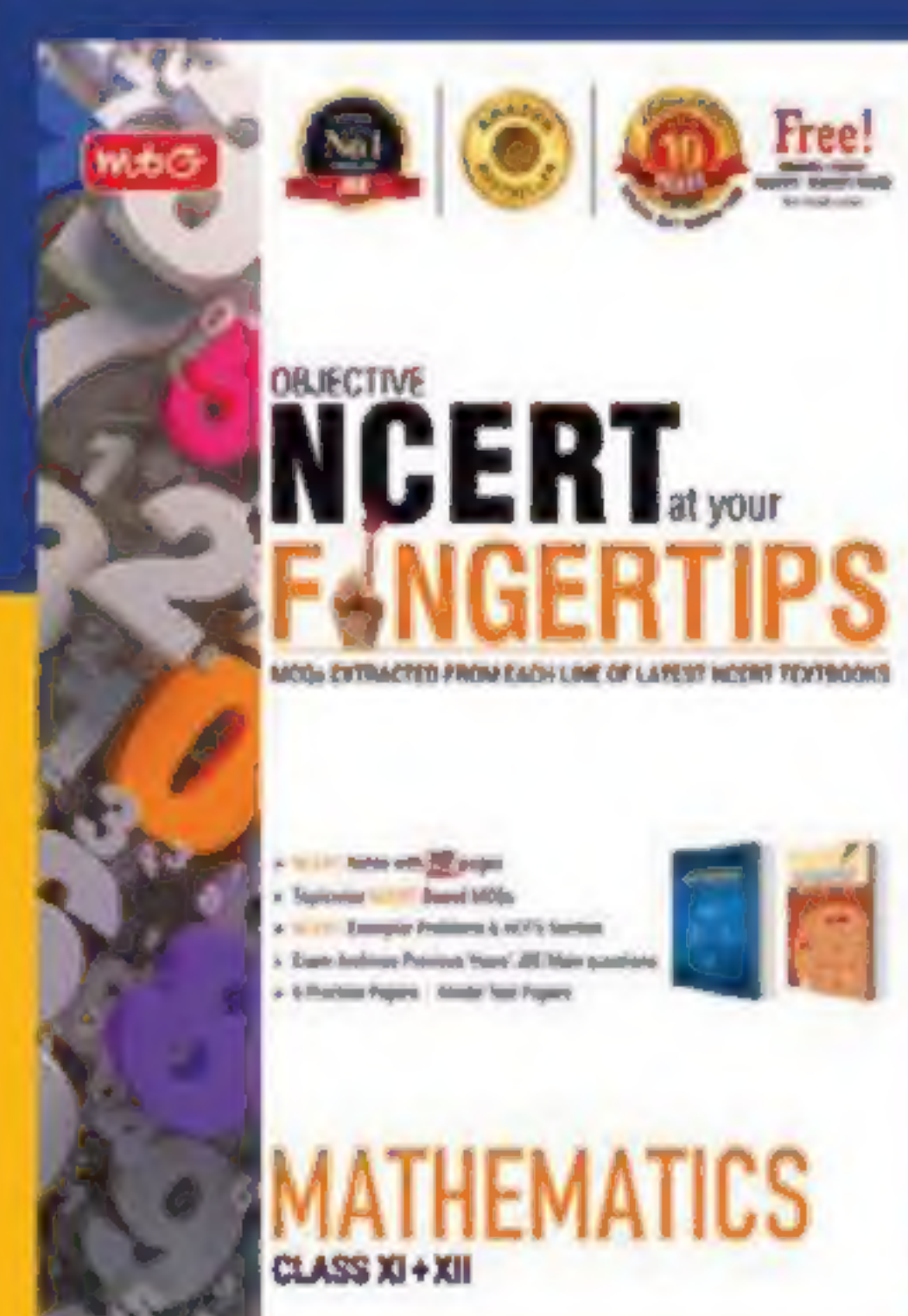
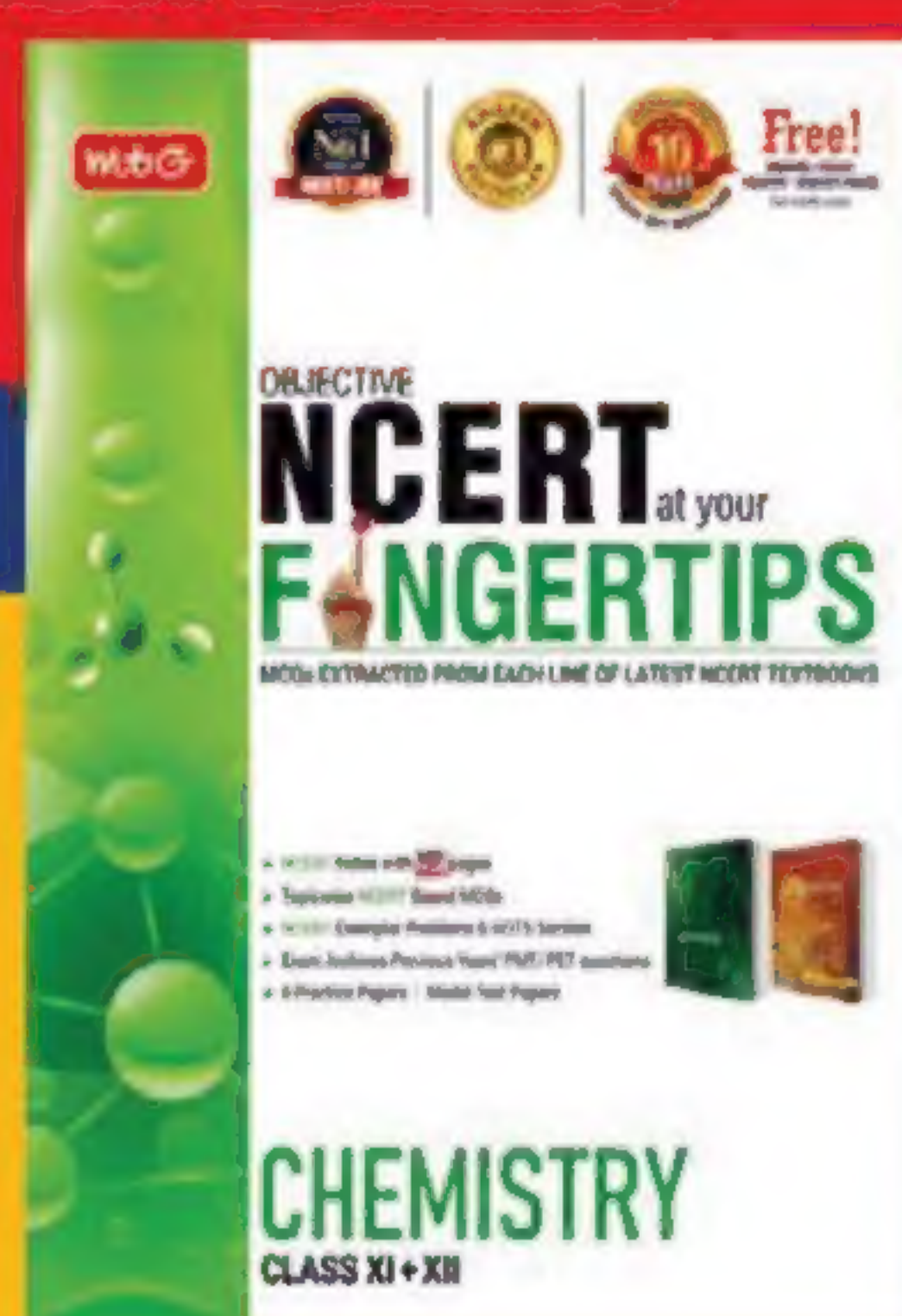
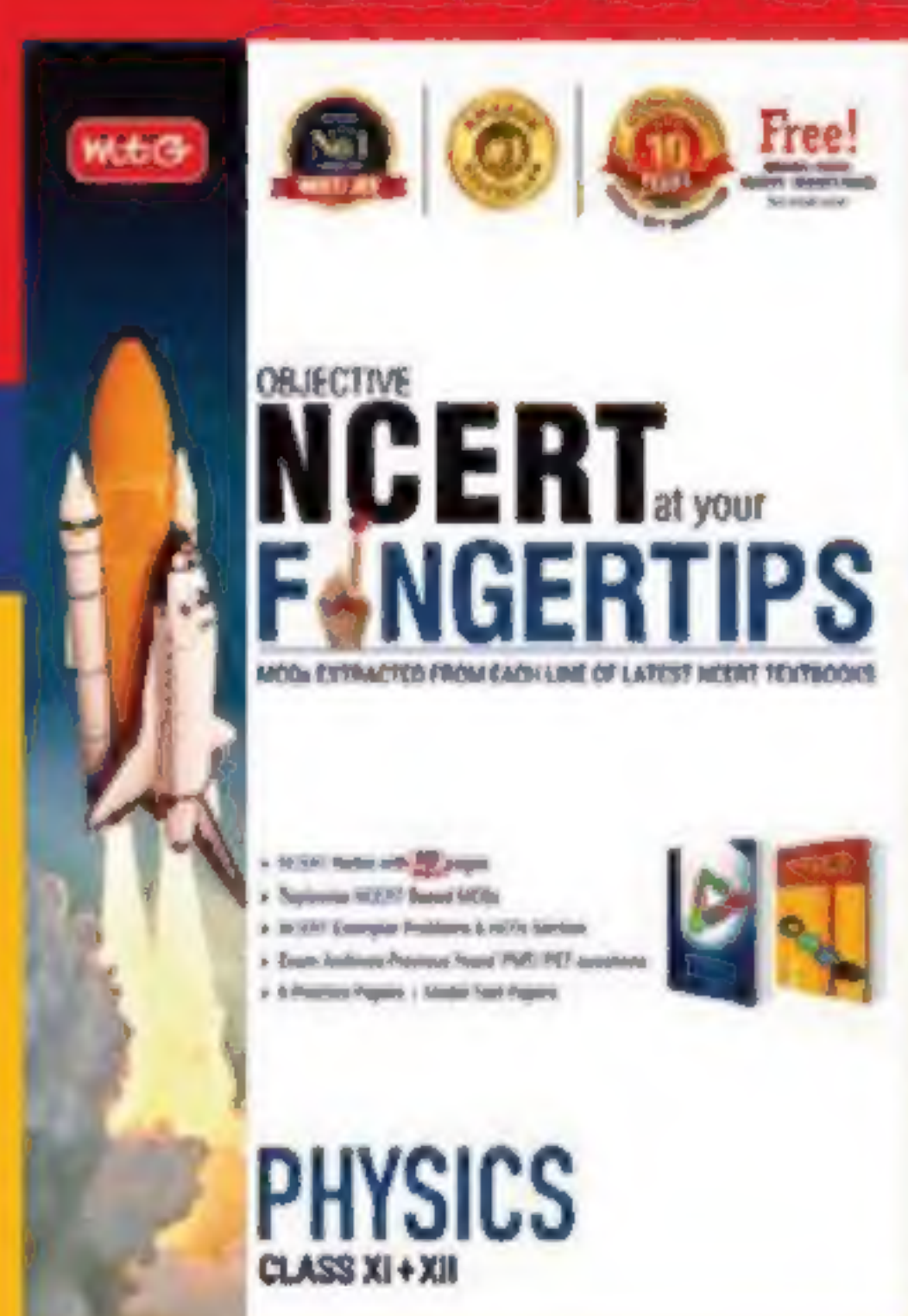
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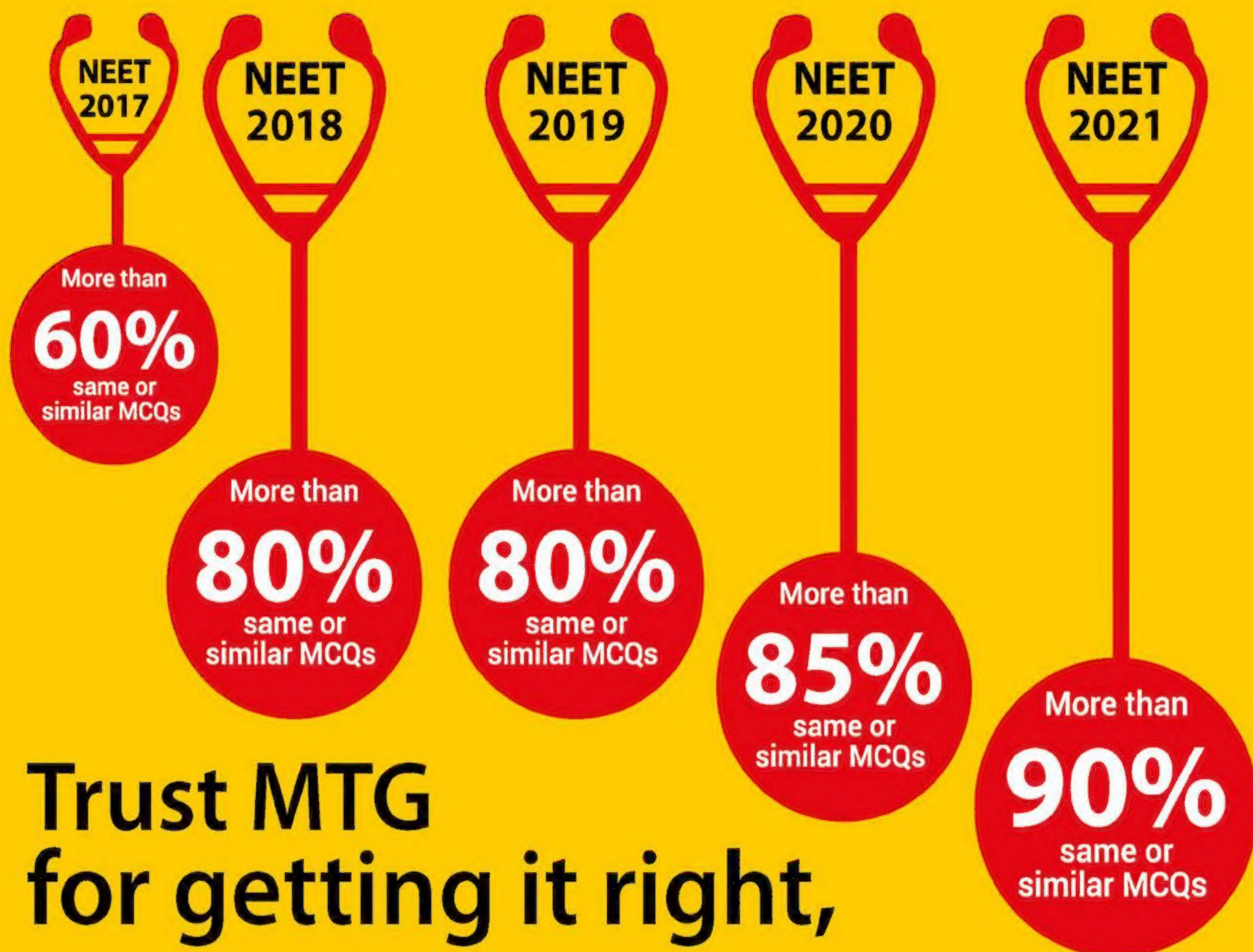


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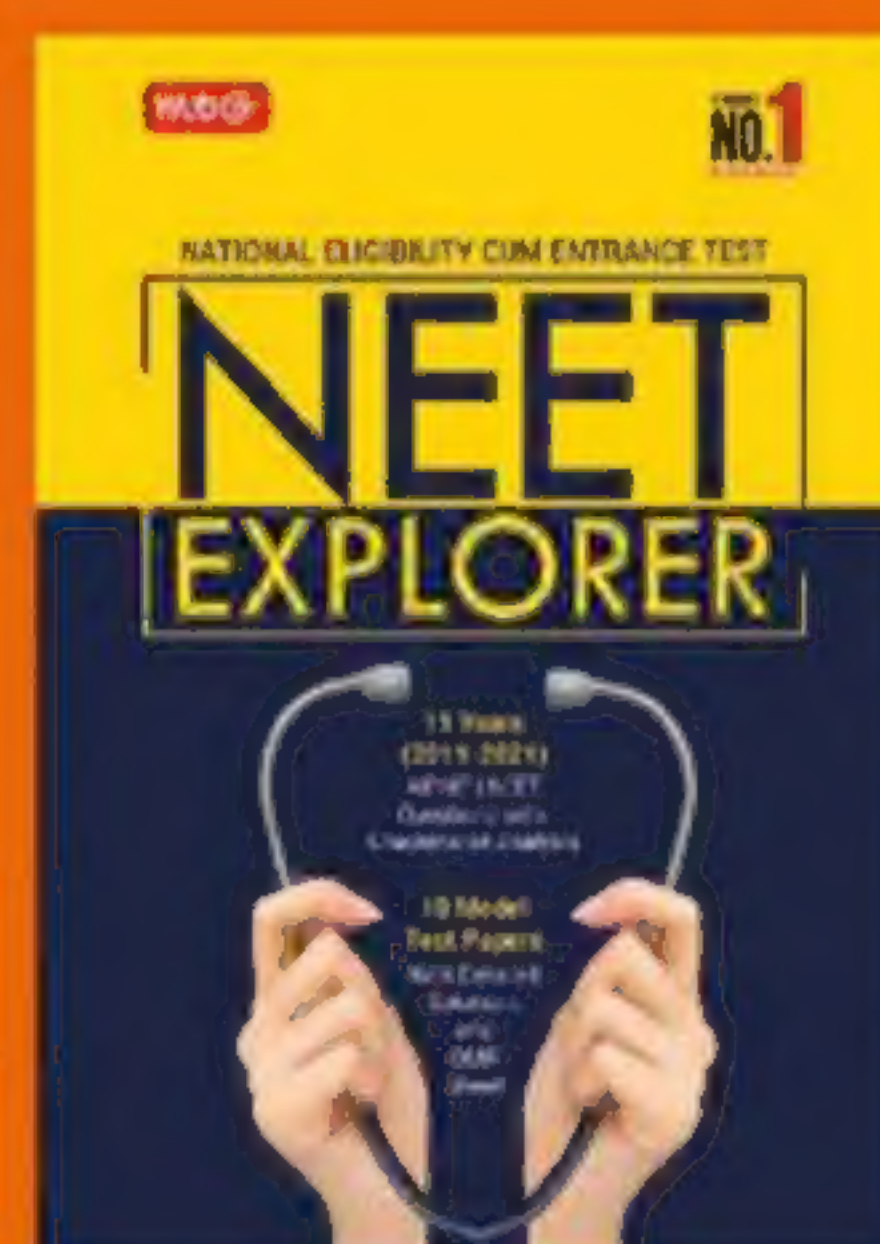
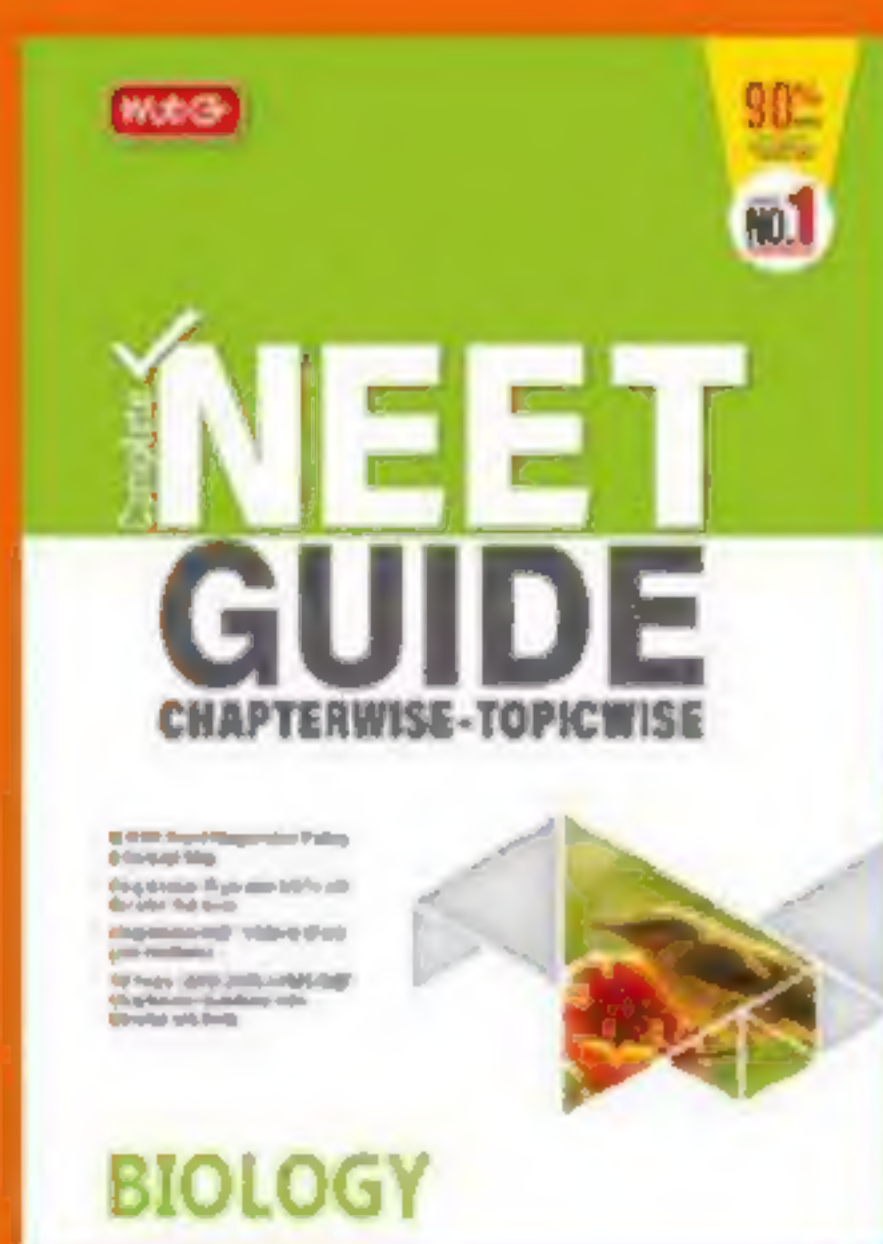
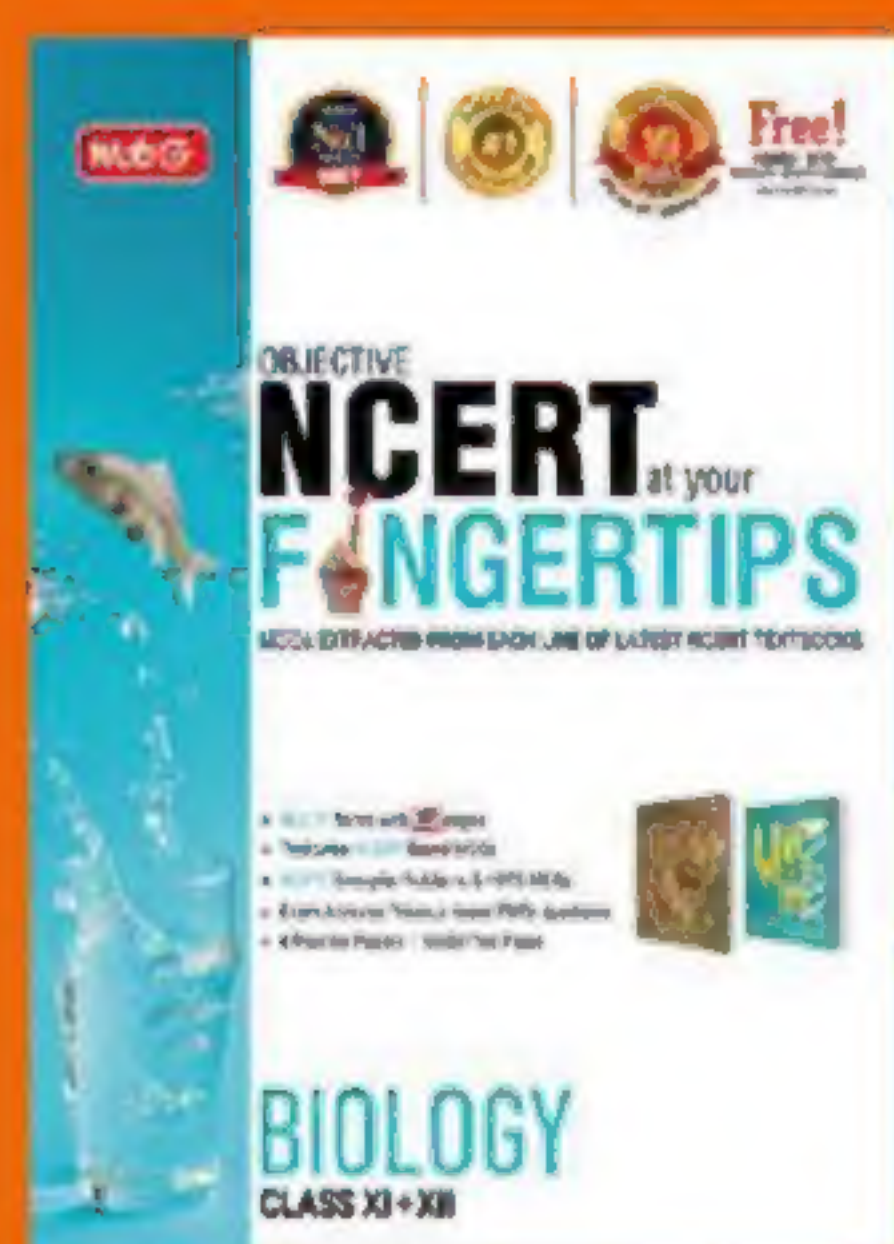
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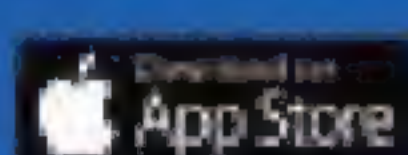
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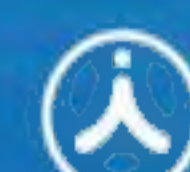


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